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AERONAUTICAL ENGINEERING

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ENGINEERING: A CONTINUING
BIBLIOGRAPHY WITH INDEXES
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AERONAUTICAL ENGINEERING

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National Aeronautics and Space Administration
Scientific and Technical Information Office
Washington, DC 1995

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INTRODUCTION

This issue of *Aeronautical Engineering — A Continuing Bibliography with Indexes* (NASA SP-7037) lists 179 reports, journal articles, and other documents recently announced in the NASA STI Database.

Accession numbers cited in this issue include:

Scientific and Technical Aerospace Reports (STAR) (N-10000 Series)

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The coverage includes documents on the engineering and theoretical aspects of design, construction, evaluation, testing, operation, and performance of aircraft (including aircraft engines) and associated components, equipment, and systems. It also includes research and development in aerodynamics, aeronautics, and ground support equipment for aeronautical vehicles.

Each entry in the publication consists of a standard bibliographic citation accompanied, in most cases, by an abstract. The listing of the entries is arranged by the first nine *STAR* specific categories and the remaining *STAR* major categories. This arrangement offers the user the most advantageous breakdown for individual objectives. The citations include the original accession numbers from the respective announcement journals.

Seven indexes—subject, personal author, corporate source, foreign technology, contract number, report number, and accession number—are included.

A cumulative index for 1995 will be published in early 1996.

The NASA CASI price code table, addresses of organizations, and document availability information are located at the back of this issue.

TYPICAL REPORT CITATION AND ABSTRACT

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← CORPORATE SOURCE

ACCESSION NUMBER → N95-10318*# Dow Chemical Co., Midland, MI.
TITLE → NOVEL MATRIX RESINS FOR COMPOSITES FOR AIRCRAFT
PRIMARY STRUCTURES, PHASE 1 Final Report, Apr. 1989 -
Mar. 1992

AUTHORS → EDMUND P. WOO, P. M. PUCKETT, S. MAYNARD, M. T. BISHOP,
K. J. BRUZA, J. P. GODSCHALX, AND M. J. MULLINS Aug. 1992 ← PUBLICATION DATE

164 p

CONTRACT NUMBERS → (Contracts NAS1-18841; RTOP 510-02-11-02)
REPORT NUMBERS → (NASA-CR-189657; NAS 1.26:189657) Avail: CASI HC A08/MFA02 ← AVAILABILITY AND
PRICE CODE

The objective of the contract is the development of matrix resins with improved processability and properties for composites for primarily aircraft structures. To this end, several resins/systems were identified for subsonic and supersonic applications. For subsonic aircraft, a series of epoxy resins suitable for RTM and powder prepreg was shown to give composites with about 40 ksi compressive strength after impact (CAI) and 200 F/wet mechanical performance. For supersonic applications, a thermoplastic toughened cyanate prepreg system has demonstrated excellent resistance to heat aging at 360 F for 4000 hours, 40 ksi CAI and useful mechanical properties at greater than or equal to 310 F. An AB-BCB-maleimide resin was identified as a leading candidate for the HSCT. Composite panels fabricated by RTM show CAI of approximately 50 ksi, 350 F/wet performance and excellent retention of mechanical properties after aging at 400 F for 4000 hours. Author

TYPICAL JOURNAL ARTICLE CITATION AND ABSTRACT

NASA SPONSORED

ACCESSION NUMBER → A95-60192* National Aeronautics and Space Administration. Ames. ← CORPORATE SOURCE
Research Center, Moffett Field, CA.

TITLE → AERODYNAMIC INTERACTIONS BETWEEN A ROTOR AND

WING IN HOVER

AUTHORS → FORT F. FELKER NASA. Ames Research Center, Moffett Field, ← AUTHOR'S AFFILIATION
CA, US and JEFFREY S. LIGHT NASA. Ames Research Center,
Moffett Field, CA, US Journal of the American Helicopter Society ← JOURNAL TITLE

PUBLICATION DATE → 2 Jun. 1986 p. 53-61
REPORT NUMBER → (HTN-94-00714) Copyright

An experimental investigation of rotor/wing aerodynamic interactions in hover is described. The investigation consisted of both a large-scale and a small-scale test. A 0.658-scale V-22 rotor and wing was used in the large-scale test. Wing download, wing surface pressure, rotor performance, and rotor downwash data from the large-scale test are presented. A small-scale experiment was conducted to determine how changes in the rotor/wing geometry affected the aerodynamic interactions. These geometry variations included the distance between the rotor and wing, wing incidence angle, wing flap angle, rotor rotation direction, and configurations both with the rotor axis at the tip of the wing (tilt rotor configuration) and with the rotor axis at the center of the wing (compound helicopter configuration). Author (Harner)

TABLE OF CONTENTS

Category 01	Aeronautics	1
Category 02	Aerodynamics Includes aerodynamics of bodies, combinations, wings, rotors, and control surfaces; and internal flow in ducts and turbomachinery.	1
Category 03	Air Transportation and Safety Includes passenger and cargo air transport operations; and aircraft accidents.	N.A.
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Category 06	Aircraft Instrumentation Includes cockpit and cabin display devices; and flight instruments.	N.A.
Category 07	Aircraft Propulsion and Power Includes prime propulsion systems and systems components, e.g., gas turbine engines and compressors; and onboard auxiliary power plants for aircraft.	14
Category 08	Aircraft Stability and Control Includes aircraft handling qualities; piloting; flight controls; and autopilots.	16
Category 09	Research and Support Facilities (Air) Includes airports, hangars and runways; aircraft repair and overhaul facilities; wind tunnels; shock tubes; and aircraft engine test stands.	18
Category 10	Astronautics Includes astronautics (general); astrodynamics; ground support systems and facilities (space); launch vehicles and space vehicles; space transportation; space communications, spacecraft communications, command and tracking; spacecraft design, testing and performance; spacecraft instrumentation; and spacecraft propulsion and power.	22
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26

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Includes mathematical and computer sciences (general); computer operations and hardware; computer programming and software; computer systems; cybernetics; numerical analysis; statistics and probability; systems analysis; and theoretical mathematics.

27

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33

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Includes social sciences (general); administration and management; documentation and information science; economics and cost analysis; law, political science, and space policy; and urban technology and transportation.

N.A.

Category 18 Space Sciences

Includes space sciences (general); astronomy; astrophysics; lunar and planetary exploration; solar physics; and space radiation.

33

Category 19 General

Subject Index	A-1
Personal Author Index	B-1
Corporate Source Index	C-1
Foreign Technology Index	D-1
Contract Number Index	E-1
Report Number Index	F-1
Accession Number Index	G-1
Appendix	APP-1

AERONAUTICAL ENGINEERING

A Continuing Bibliography (Suppl. 313)

January 1995

01

AERONAUTICS (GENERAL)

N95-10709* National Aeronautics and Space Administration. Hugh L. Dryden Flight Research Center, Edwards, CA.

DRYDEN AND TRANSONIC RESEARCH (Videotape)
27 May 1992 Presented at the 20th Anniversary F-8 Digital Fly-By-Wire (DFBW) and Supercritical Wing (SCW) Symposium Videotape: 30 min. playing time, in color, with sound (NASA-TM-104281; NONP-NASA-VT-94-23629) Avail: CASI VHS A01/BETA A22

This video on transonic research is given by Dryden engineer Ed Saltzman as part of the 20th Anniversary F-8 Digital Fly-By-Wire (DFBW) and Supercritical Wing (SCW) Symposium. DFRC

N95-10749* National Aeronautics and Space Administration. Hugh L. Dryden Flight Research Center, Edwards, CA.

NACA/NASA: X-1 THROUGH X-31 (Videotape)
4 Apr. 1994 Videotape: 28 min. playing time, in color, no sound (NASA-TM-104304; NONP-NASA-VT-94-23649) Avail: CASI VHS A01/BETA A22

This video presents clips (in-flight, ground crew, pilots, etc.) of almost everything from X-1 through X-31. DFRC

N95-11463*# National Aeronautics and Space Administration, Washington, DC.

GENERAL AVIATION TASK FORCE REPORT

Sep. 1993 69 p
(NASA-TM-109950; NAS 1.15:109950) Avail: CASI HC A04/MF A01

General aviation is officially defined as all aviation except scheduled airlines and the military. It is the only air transportation to many communities throughout the world. In order to reverse the recent decline in general aviation aircraft produced in the United States, the Task Force recommends that NASA provide the expertise and facilities such as wind tunnels and computer codes for aircraft design. General aviation manufacturers are receptive to NASA's innovations and technological leadership and are expected to be effective users of NASA-generated technologies. CASI

02

AERODYNAMICS

Includes aerodynamics of bodies, combinations, wings, rotors, and control surfaces; and internal flow in ducts and turbomachinery.

A95-60160* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.

NAVIER-STOKES SIMULATION OF ROTOR-BODY FLOWFIELD

IN HOVER USING OVERSET GRIDS

G. R. SRINIVASAN JAI Associates, Inc., Mountain View, CA, U.S.A. and J. U. AHMAD JAI Associates, Inc., Mountain View, CA, U.S.A. 1993 12 p. European Rotorcraft Forum, 19th, Como, Italy, Sep. 14-16, 1993 (Contract NAS2-13534)

(PAPER C15; HTN-94-00673) Copyright

A free-wake Navier-Stokes numerical scheme and multiple Chimera overset grids have been utilized for calculating the quasi-steady hovering flowfield of a Boeing-360 rotor mounted on an axisymmetric whirl-tower. The entire geometry of this rotor-body configuration is gridded-up with eleven different overset grids. The composite grid has 1.3 million grid points for the entire flow domain. The numerical results, obtained using coarse grids and a rigid rotor assumption, show a thrust value that is within 5% of the experimental value at a flow condition of $M(\text{sub tip}) = 0.63$, $\Theta(\text{sub c}) = 8^\circ$, and $Re = 2.5 \times 10^6$. The numerical method thus demonstrates the feasibility of using a multi-block scheme for calculating the flowfields of complex configurations consisting of rotating and nonrotating components. Author (Herner)

A95-60164* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.

AN EXPERIMENTAL INVESTIGATION OF WING TIP TURBULENCE WITH APPLICATIONS TO AEROSOUND

S. A. MCINERNEY Calif. Univ., Los Angeles, CA, US, W. C. MEECHAM Calif. Univ., Los Angeles, CA, US, and P. T. SODERMAN NASA Ames Research Center, Moffett Field, CA, US 9 Jul. 1986 20 p. AIAA Aeroacoustics Conference, 10th, Seattle, WA, July 9-11, 1986 (AIAA PAPER 86-1918; HTN-94-00678) Copyright

Wind tunnel tests were performed to measure the turbulence characteristics of flow in the wing tip region of a blunt tipped NACA 0012 airfoil at angles of attack of 16, 12 and 6 deg and flow speeds of 75, 55, and 35 m/s. Reynolds numbers based on the chord length ranged from 1.8×10^6 to 3.8×10^6 . Hot wire measurements were made at an angle of attack of 12 deg and $U(\text{infinity}) = 55$ ms. These indicate fluctuation velocities on the order of 0.13 $U(\text{infinity})$ in the tip region. Surface pressure spectra are presented for $\alpha = 12^\circ$ and 16° ; surface-pressure cross-correlations are presented for $\alpha = 16^\circ$. These suggest the presence of a well organized turbulence structure with a peak Strouhal number 0.8 to 1.1 based on the wing thickness. High frequency turbulence of lesser intensity was measured at positions near the primary tip vortex on the upper wing surface. A separation region with a spectral peak of St approximately equal to 0.4 was recorded at $\alpha = 16^\circ$ for the transducer located on the low pressure side of the wing nearest the trailing edge. Surface-surface cross correlations display a double, echo like structure. Near-field correlations indicate that the well ordered tip turbulence and the separation region on the upper surface both radiate significant levels of far field sound. The use of cross correlation techniques in the wind tunnel has permitted treatment of radiated sound levels which are 25 and more dB below tunnel background levels. Author (Herner)

02 AERODYNAMICS

A95-60169* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.

RECENT ADVANCES IN EULER AND NAVIER-STOKES METHODS FOR CALCULATING HELICOPTER ROTOR AERODYNAMICS AND ACOUSTICS

G. R. SRINIVASAN JAI Associates, Inc., Moffett Field, CA, US and J. D. BAEDER US Army Aeroflightdynamics Directorate, Moffett Field, CA, US 9 Sep. 1991 6 p. International Symposium of Computational Fluid Dynamics, 4th, Davis, CA, Sep. 9-12, 1991, Paper (Contract DAAL03-90-C-0013)

(HTN-94-00686) Copyright

This paper outlines some recent advances in the application of the Euler and Navier-Stokes computational fluid dynamics methods to analyze nonlinear problems of helicopter aerodynamics and acoustics. A complete flowfield simulation of helicopters is currently not feasible with these methods. However, the use of the state-of-the-art numerical algorithms in conjunction with powerful supercomputers, like the Cray-2, have enabled notable progress to be made in modeling several individual components of this complex flow in hover and forward flight.

Author (Hemer)

A95-60173* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.

COMPUTATION OF NONEQUILIBRIUM VISCOUS FLOWS IN ARC-JET WIND TUNNEL NOZZLES

TAHIR GOKCEN Eloret Corp., Palo Alto, CA, US 10 Jan. 1994 10 p. Aerospace Sciences Meeting and Exhibit, 32nd, Reno, NV, Jan. 10-13, 1994

(Contract NCC2-420)

(AIAA PAPER 94-0254; HTN-94-00694) Copyright

The axisymmetric Navier-Stokes equations are numerically solved for air flows in converging-diverging conical nozzles. A nonequilibrium formulation with a two-temperature thermochemical model has been employed for vibrationally excited, partially dissociated and ionized air. Evaluations of the formulation is made through comparisons of the computed flow quantities with the experimental data obtained in expanding arc-jet nozzle flows. Two sets of experimental data obtained in conical nozzles with geometric exit-to-throat area ratios of 625 and 8100 cover reservoir pressures ranging from 5 to 95 atm and enthalpies from 5 to 10 MJ/kg. The computed results are in good agreement with local mass flux, Pitot pressure, and static wall pressure measurements at the nozzle exit. For low pressure reservoir conditions, comparisons of computations with the experimental data indicate that the wall catalytic is very important in predicting species mole fraction at the nozzle exit since gas phase chemistry is frozen. The current computations overpredict the atomic oxygen concentrations which in turn results in underprediction of the vibrational temperature.

Author (Hemer)

A95-60174 COMPREHENSIVE AEROMECHANICS ANALYSIS OF COMPLEX ROTORCRAFT USING 2GCHAS

ROBERT A. ORMISTON U.S. Army Aeroflightdynamics Directorate, Moffett Field, CA, U.S., MICHAEL J. RUTKOWSKI U.S. Army Aeroflightdynamics Directorate, Moffett Field, CA, U.S., GENE C. RUZICKA U.S. Army Aeroflightdynamics Directorate, Moffett Field, CA, U.S., HOSSEIN SABERI Advanced Rotorcraft Technology, Inc., Mountain View, CA, US, and YOON JUNG Advanced Rotorcraft Technology, Inc., Mountain View, CA, US 19 Jan. 1994 24 p. American Helicopter Society Aeromechanics Specialists Conference, San Francisco, CA, Jan. 19-21, 1994, Paper (HTN-94-00695) Copyright

The Second Generation Comprehensive Helicopter Analysis System (2GCHAS) is a comprehensive, multi-disciplinary, computer software system for predicting rotorcraft aeromechanics characteristics. It is a finite element based system with a variety of aerodynamic modeling options and provides modeling and analysis flexibility, prediction accuracy, and user-friendly input and output. The software is maintainable, expandable, and transportable to various computer platforms. The paper briefly describes the development of the system and key features for modeling complex rotorcraft. A series of rotorcraft

analysis problems is presented to illustrate the range of capabilities available, including single and tandem rotor helicopters with engine/drive trains and feedback flight control systems. Various aerodynamic airloads, rotor wake, and component interference models are used in calculating performance, flight dynamic response, rotor loads and vibrations, and aeroelastic stability.

Author (Hemer)

A95-60176

FIRST LEVEL RELEASE OF 2GCHAS FOR COMPREHENSIVE HELICOPTER ANALYSIS - A STATUS REPORT

MICHAEL J. RUTKOWSKI U.S. Army Aeroflightdynamics Directorate, Moffett Field, CA, US, GENE C. RUZICKA U.S. Army Aeroflightdynamics Directorate, Moffett Field, CA, US, ROBERT A. ORMISTON U.S. Army Aeroflightdynamics Directorate, Moffett Field, CA, US, and WENDELL B. STEPHENS U.S. Army Aeroflightdynamics Directorate, Moffett Field, CA, US 25 Mar. 1991 26 p. AHS International Technical Specialists Meeting on Rotorcraft Basic Research, Atlanta, GA, Mar. 25-27, 1991, Paper Research sponsored by Sterling Federal Systems (HTN-94-00697) Copyright

The Second Generation Comprehensive Helicopter Analysis System (2GCHAS) is being developed by the Aeroflightdynamics Directorate of the U.S. Army Aviation Systems Command (AVSCOM) to provide a significant advance in rotorcraft analysis capability. The paper will describe recent progress that led to the completion of the beta test version of the First Level Release in December 1990. This paper is intended to describe the current status of the Project and where it will be going. The paper will describe the project management approach, 2GCHAS engineering capabilities and features, documentation, and the user interface. System integration test results as well as technical issues and solutions will be described.

Author (Hemer)

A95-60177

ANALYSIS OF FLOW CHANNELING NEAR THE WALL IN PACKED BEDS

S. M. WHITE Univ. of California, Berkeley, CA, US and C. L. TIEN Univ. of California, Berkeley, CA, US Warme-und Stoffubertragung vol. 21 1987 p. 291-296 (HTN-94-00698) Copyright

The phenomenon of flow channeling in packed beds is investigated in the present analysis. A closed-form solution is obtained from the volume-averaged second-order momentum equation with the no-slip condition at the wall, using an exponential porosity distribution typical of packed beds. The predicted velocity profile shows the most important features of flow channeling: the sharp peak in the velocity near the wall, and the approach to the Darcy velocity far from the wall. The predictions are consistent with previous numerical results and with velocity measurements made downstream of a packed bed. The compact expression for the velocity given here is shown to be convenient for analyzing other packed-bed characteristics, such as the effective permeability of a finite-sized bed.

Author (Hemer)

A95-60178* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA. JET TO FREESTREAM VELOCITY RATIO COMPUTATIONS FOR A JET IN A CROSSFLOW

RICHARD J. MARGASON NASA Ames Research Center, Moffett Field, CA, US and JIN TSO Calif. Polytechnic St. Univ., San Luis Obispo, CA, US 1 Dec. 1993 12 p. International Powered Lift Conference, Santa Clara, CA, Dec. 1-3, 1993 (AIAA PAPER 93-4860; HTN-94-00699) Copyright

The flowfield induced by a single, subsonic jet exhausting perpendicularly from a flat plate into a subsonic crossflow has been numerically investigated. Time-averaged solutions were obtained using the thin-layer Navier-Stokes equations and two overlapping grids. Test cases were chosen to match available experimental data where the jet Mach number was 0.78 and the freestream Mach number was varied to represent effective velocity ratios R from 4 to 12. Comparisons of the pressures induced on the flat plate are presented. The results show that the best agreement is obtained for R of 4 and 6, R of 8 is more difficult to resolve, and the R of 12 solution was not satisfactory. It is anticipated

that the resolution could be improved by using either smaller time steps or finer grid spacing as R increases.
Author (Herner)

A95-60179* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.

NUMERICAL SIMULATION OF POWERED-LIFT FLOWS

WILLIAM R. VAN DALSEM NASA. Ames Research Center, Moffett Field, CA, US, KALPANA CHAWLA NASA. Ames Research Center, Moffett Field, CA, US, MERRITT H. SMITH NASA. Ames Research Center, Moffett Field, CA, US, and PATRICIA A. ABELOFF Colorado Univ., Boulder, CO, US 1990 15 p. International Powered lift Conference, Aug. 29-31, 1990, Paper (HTN-94-00700) Copyright

This article presents work performed at NASA's Ames Research Center involving the application of Computational Fluid Dynamics (CFD) to the prediction of flows encountered by powered-lift aircraft operating in ground effect. These flows are characterized by jet and jet-induced flows interacting with the ground and aerodynamic surfaces. Over the last five years, work has progressed from simulating the interaction of a single jet impacting on a ground plane, through the simulation of a delta planform with multiple jets in ground effect, to an ongoing effort to simulate the complete flow about a Harrier AV-8B in ground effect. Efforts have also been made to predict the thermal interaction between hot propulsive jets and a landing surface of arbitrary thermal properties. Progress to date in each of these areas will be outlined.
Author (Herner)

A95-60180* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.

DRYDEN LECTURESHIP IN RESEARCH, A PERSPECTIVE ON CFD VALIDATION

JOSEPH G. MARVIN NASA. Ames Research Center, Moffett Field, CA, US 11 Jan. 1993 13 p. Aerospace Sciences Meeting, 31st, Reno, NV, Jan. 11-14, 1993 (AIAA PAPER 93-0002; HTN-94-00701) Copyright

A comprehensive approach to CFD validation is presented. Requirements from computational and experimental perspectives are given. Experimental validation is emphasized because it ultimately determines the accuracy of CFD modeling and its application to complex problems. The concepts of building block and benchmark experiments are introduced. The types of measurements required of these experiments and their accuracy determination are explained. Contributions from such experiments toward the development and validation of CFD are reviewed and examples provided. Future challenges and strategies for validation are discussed.
Author (Herner)

A95-60181* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.

ACCURACY ENHANCEMENTS FOR OVERSET GRIDS USING A DEFECT CORRECTION APPROACH

STUART E. ROGERS NASA. Ames Research Center, Moffett Field, CA, U.S.A. and THOMAS H. PULLIAM NASA. Ames Research Center, Moffett Field, CA, U.S.A. 10 Jan. 1994 10 p. Aerospace Sciences Meeting and Exhibit, 32nd, Reno, NV, Jan. 10-13, 1994 (AIAA PAPER 94-0523; HTN-94-00702) Copyright

A defect-correction approach is investigated as a means of enhancing the accuracy of flow computations on overset grids. Typically, overset-grid techniques process and pass information only at grid boundaries. In the current approach, error corrections at all overlapped interior points are injected between grids by using a defect-correction scheme. In some cases this is found to enhance the overall accuracy of the overset-grid method. Locally refined overset grids can be used to provide an efficient solution-adaptation method. The defect correction can also be utilized as an error-correction technique for a coarse grid by evaluating the residual using a fine base grid, but solving the implicit equations only on the coarse grid. Numerical examples include an accuracy and dissipation study of an unsteady decaying vortex flow,

the flow over a NACA 0012 airfoil, and the flow over a multi-element high-lift airfoil.
Author (Herner)

A95-60182* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.

INTERFEROMETRY AND COMPUTATIONAL STUDIES OF AN OSCILLATING AIRFOIL COMPRESSIBLE DYNAMIC STALL FLOW FIELD

M. S. CHANDRASEKHARA Naval Postgraduate School, Monterey, CA, U.S.A., L. W. CARR NASA. Ames Research Center, Moffett Field, CA, U.S.A., and J. A. EKATERINARIS Naval Postgraduate School, Monterey, CA, U.S.A. 10 Aug. 1992 4p. Asian Congress of Fluid Mechanics, 5th, Taejeon, Korea, Aug. 10-14, 1992, Paper (HTN-94-00703) Copyright

A unique comparison has been made between real time interferograms and full Navier-Stokes computations of the density field over an oscillating airfoil undergoing dynamic stall for compressible flow conditions. Good agreement was found until a dynamic stall vortex formed in the flow. Subsequent evolution of the flow field was found to be very different in the computations. The reasons for this difference have been explained in terms of the leading edge region flow physics and the refined flow modeling that needs to be used for the post-stall flow field.
Author (Herner)

A95-60183 OSCILLATING AIRFOIL COMPRESSIBLE DYNAMIC STALL STUDIES

M. S. CHANDRASEKHARA Naval Postgraduate School, Monterey, CA, US 12 Dec. 1992 21 p. International Symposium on Advances in Aerospace Sciences and Engineering, Paper (HTN-94-00704) Copyright

A summary of the recent results on studies of compressibility effects on dynamic stall of an oscillating airfoil is presented. The study used three different optical flow measurement techniques to obtain the information. These are the schlieren method, real time interferometry, and laser Doppler velocimetry, all applied to unsteady flows. The measurements show that compressibility effects dominate the flow once Mach number exceeds 0.3. Dynamic stall occurs at progressively lower angles of attack as the Mach number is increased above this value. Increasing the degree of unsteadiness (reduced frequency), however, has the opposite effect of delaying stall, even under compressibility conditions. Studies to obtain other flow details showed that a separation bubble forms during the upstroke of the airfoil, which bursts almost coincidentally with the formation of the dynamic stall vortex. The distinction between the two events could not be made due to the rapidity of the onset of the dynamic stall process. As much as 2 degrees of delay in angle of attack was found to be possible by oscillating the airfoil and the reason was determined to be due to the slower development of the leading edge pressure distribution in the unsteady case. The flow velocity was found to reach values as high as 1.6 times the free stream value, even far away from the airfoil. A separation bubble was also found to form during the reattachment process on the downstroke, with a large hysteresis present.
Author (Herner)

A95-60184* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.

DYNAMIC STALL OF AN OSCILLATING WING. PART 1:

EVALUATION OF TURBULENCE MODELS

G. R. SRINIVASAN JAI Associates, Inc., Mt. View, CA, US, J. A. EKATERINARIS Navy-NASA Joint Inst. of Aeronautics, Moffett Field, CA, US, and W. J. MCCROSKEY US Army Aeroflight dynamics Directorate Moffett Field, Moffett Field, CA, US 9 Aug. 1993 31 p. AIAA Applied Aerodynamics Conference, 11th, Monterey, CA, Aug. 9-11, 1993 (Contract DAAL03-90-C-0013) (AIAA PAPER 93-3403; HTN-94-00705) Copyright

Unsteady flowfields of a two-dimensional oscillating wing are calculated using an implicit, finite-difference, Navier-Stokes numerical scheme using five widely used turbulence models. The objective of this

02 AERODYNAMICS

study is to identify an appropriate turbulence model for accurate simulation of three-dimensional dynamic stall. Three unsteady flow conditions corresponding to attached flow, light-stall, and deep-stall of an oscillating wing experiment were chosen as test cases for computations. Results of unsteady airload hysteresis curves, harmonics of unsteady pressures, and instantaneous flow pictures are presented. Comparison of unsteady airloads with experiment show that all models are deficient in some sense and not a single model predicts all airloads consistently and in agreement with experiment for all flow conditions. For the attached flow condition, the Renormalization Group Theory (RNG), the Johnson-King (J-K), and the Spalart-Allmaras (S-A) models have better performance. The Baldwin-Lomax (B-L) and the Baldwin-Barth (B-B) models fair poorly. At the light-stall condition, the results for the RNG, the J-K, and S-A models are in agreement with experiment for the upstroke but they all over predict the separation shown by the experiment and therefore have bigger hysteresis loops than experimental results. The B-B model results are also in good agreement for upstroke but have poor lift hysteresis for downstroke. It has superior drag and pitching-moment predictions. For deep-stall conditions, the airloads for the RNG, the B-B, and the S-A models have fair agreement with experiment, but the B-B model performed better at the extreme deep-stall condition. Overall, the RNG model provides significant improvement over the B-L model in all flow regimes with no additional computational cost. The Baldwin-Barth model is the most expensive of the models considered here, costing about 2.5 times that of the Baldwin-Lomax model. Finally, a brief discussion of the effects of grid density, time-step size, and numerical dissipation on the unsteady solutions are also presented. Author (Herner)

A95-60185* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.

A COMPARISON OF TURBULENCE MODELS IN COMPUTING MULTI-ELEMENT AIRFOIL FLOWS

STUART E. ROGERS NASA. Ames Research Center, Moffett Field, CA, US, FLORIAN MENTER Eloret Institute, Sunnyvale, CA, US, PAUL A. DURBIN Stanford University, Palo Alto, CA, US, and NAGI N. MANSOUR NASA. Ames Research Center, Moffett Field, CA, US 10 Jan. 1994 13 p. AIAA Aerospace Sciences Meeting and Exhibit, 32nd, Reno, NV, Jan. 10-13, 1994

(AIAA PAPER 94-0291; HTN-94-00707) Copyright

Four different turbulence models are used to compute the flow over a three-element airfoil configuration. These models are the one-equation Baldwin-Barth model, the one-equation Spalart-Allmaras model, a two-equation k- ω model, and a new one-equation Durbin-Mansour model. The flow is computed using the INS2D two-dimensional incompressible Navier-Stokes solver. An overset Chimera grid approach is utilized. Grid resolution tests are presented, and manual solution-adaptation of the grid was performed. The performance of each of the models is evaluated for test cases involving different angles-of-attack, Reynolds numbers, and flap riggings. The resulting surface pressure coefficients, skin friction, velocity profiles, and lift, drag, and moment coefficients are compared with experimental data. The models produce very similar results in most cases. Excellent agreement between computational and experimental surface pressures was observed, but only moderately good agreement was seen in the velocity profile data. In general, the difference between the predictions of the different models was less than the difference between the computational and experimental data. Author (Herner)

A95-60186* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.

A COMPARISON OF THREE-DIMENSIONAL NONEQUILIBRIUM SOLUTION ALGORITHMS APPLIED TO HYPERSONIC FLOWS WITH STIFF CHEMICAL SOURCE TERMS

GRANT PALMER NASA. Ames Research Center, Moffett Field, CA, US and ETHIRAJ VENKATAPATHY Eloret Corp., Palo Alto, CA, US 6 Jul. 1993 19 p. AIAA Thermophysics Conference,

28th, Orlando, FL, July 6-9, 1993

(AIAA PAPER 93-2861; HTN-94-00708) Copyright

Three solution algorithms, explicit underrelaxation, point implicit, and lower upper symmetric Gauss-Seidel (LUSGS), are used to compute nonequilibrium flow around the Apollo 4 return capsule at 62 km altitude. By varying the Mach number, the efficiency and robustness of the solution algorithms were tested for different levels of chemical stiffness. The performance of the solution algorithms degraded as the Mach number and stiffness of the flow increased. At Mach 15, 23, and 30, the LUSGS method produces an eight order of magnitude drop in the L2 norm of the energy residual in 1/3 to 1/2 the Cray C-90 computer time as compared to the point implicit and explicit under-relaxation methods. The explicit under-relaxation algorithm experienced convergence difficulties at Mach 23 and above. At Mach 40 the performance of the LUSGS algorithm deteriorates to the point it is out-performed by the point implicit method. The effects of the viscous terms are investigated. Grid dependency questions are explored. Author (Herner)

A95-60187* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.

NUMERICAL SIMULATION OF A COMPLETE STOVL AIRCRAFT IN GROUND EFFECT

MERRITT H. SMITH NASA. Ames Research Center, Moffett Field, CA, U.S.A., KALPANA CHAWLA NASA. Ames Research Center, Moffett Field, CA, U.S.A., and WILLIAM R. VAN DALSEM NASA. Ames Research Center, Moffett Field, CA, U.S.A. 1 Dec. 1993 12 p. AIAA International Powered Lift Conference, Santa Clara, CA, Dec. 1-3, 1993

(AIAA PAPER 93-4880; HTN-94-00709) Copyright

The aerodynamic environment encountered by powered-lift aircraft operating in ground effect is unique among flight vehicles. It is characterized by low forward speed with embedded regions of high subsonic or supersonic jet flows. During ground effect operations, complex recirculating flows generated by the jets produce large changes in the aerodynamic loads on the flight vehicle. Analytic prediction and small-scale experimental methods have produced mixed results in this flight regime, with the result that costly full-scale powered tests are required to evaluate the performance of candidate designs. The ability to accurately predict vehicle performance without resorting to full-scale tests will be critical to future powered-lift aircraft projects. This paper summarizes efforts to predict the flow field about a powered-lift aircraft, the YAV-8B Harrier, in low level jet-borne flight by solution of the Reynolds-averaged Navier-Stokes equations. Results are compared to infrared images of the NASA YAV-8B Harrier VISTOL Systems Research Aircraft (VSRA) under similar flight conditions.

Author (Herner)

A95-60188* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.

WING DOWNLOAD REDUCTION USING VORTEX TRAPPING PLATES

JEFFREY S. LIGHT NASA. Ames Research Center, Moffett Field, CA, US, PAUL M. STREMELE NASA. Ames Research Center, Moffett Field, CA, US, and ALAN J. BILANIN Continuum dynamics, Inc., Princeton, NJ, US 19 Jan. 1994 11 p. American Helicopter Society Aeromechanics Specialists Meeting, Jan. 19-21, 1994, Paper (HTN-94-00710) Copyright

A download reduction technique using spanwise plates on the upper and lower wing surfaces has been examined. Experimental and analytical techniques were used to determine the download reduction obtained using this technique. Simple two-dimensional wind tunnel testing confirmed the validity of the technique for reducing two-dimensional airfoil drag. Computations using a two-dimensional Navier-Stokes analysis provided insight into the mechanism causing the drag reduction. Finally, the download reduction technique was tested using a rotor and wing to determine the benefits for a semispan configuration representative of a tilt rotor aircraft.

Author (Herner)

A95-60189* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.

AN ASSESSMENT OF UPPER SURFACE BLOWING FOR THE REDUCTION OF TILT ROTOR DOWNLOAD

ROBERT E. FAYE Calif. Polytechnic Inst., San Luis Obispo, CA, US, FORT F. FELKER NASA. Ames Research Center, Moffett Field, CA, US, and JEFFREY S. LIGHT NASA. Ames Research Center, Moffett Field, CA, US 1987 9 p. AIAA Applied Aerodynamics Conference, 5th, Monterey, CA, August 1987, Paper (HTN-94-00711) Copyright

A study evaluating the use of upper-surface blowing to reduce the wing download on a V-22 tilt rotor aircraft has been completed. The study assesses the penalties associated with the upper-surface blowing system (compressor weight, compressor power, etc.), and the reduction in wing download, for a wide range of blowing slot heights and blowing pressure ratios. Three wing configurations were investigated: blowing at both leading and trailing edges with no change in wing platform relative to the V-22 tilt rotor aircraft, blowing at both leading and trailing edges with a 25% reduction in wing chord, and blowing at the leading edge only with the flap deflected 75 deg. Predicted download is presented for all of these configurations, and is compared with the download of the baseline V-22 tilt rotor aircraft configuration. The optimum configuration had 15% less net download than the baseline V-22 configuration. Author (Herner)

A95-60190* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.

STUDY OF NOISE ON A SMALL-SCALE HOVERING TILT ROTOR

MARIANNE MOSHER NASA. Ames Research Center, Moffett Field, CA, US and JEFFREY S. LIGHT NASA. Ames Research Center, Moffett Field, CA, US 1994 14 p. American Helicopter Society Aeromechanics Specialists Conference, San Francisco, California, January 19-21, 1994, Paper (HTN-94-00712) Copyright

A study of the noise from a small-scale, semi-span test of a hovering tilt rotor is presented. The effect on noise of the tilt rotor fountain and of several tilt rotor configuration changes is examined. Measurements were made of an isolated rotor; rotor and wing; rotor and image plane; and rotor, wing and image plane. This last configuration models a tilt rotor. With a tilt rotor, the wing turns some of the rotor downwash inboard. When the flows meet, some of the flow is forced upward creating a fountain. Some of the fountain is ingested into the rotor disc. Rotor fountain interactions produce very unsteady impulsive noise to the rear of the aircraft. Configuration changes to investigate download reduction included increasing the rotor/wing separation, deflecting the flap, adding the nacelle, adding vortex trapping plates and blowing on the upper surface. These configuration changes produced little or no effect on the noise, although they changed the net download. Increasing the wing span, however, reduced the annoying content of this impulse noise about 2dB. Author (Herner)

A95-60191* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.

LDV MEASUREMENTS IN DYNAMICALLY SEPARATED FLOWS

M. S. CHANDRASEKHARA Naval Postgraduate School, Monterey, CA, U.S.A. and R. D. VANDYKEN Naval Postgraduate School, Monterey, CA, U.S.A. In Laser Anemometry Advances and Applications: Proceedings of the Fifth International Conference, Koningshof, Veldhoven, The Netherlands, Aug. 23-27, 1993 (SPIE Vol. 2052) Bellingham, WA SPIE 1993 p. 305-312 (Contracts MIPR-114-91; MIPR-130-92; MIPR-92-0004) (ISBN 0-8194-1311-9; HTN-94-00713) Copyright

Two component, phase averaged mean velocity data have been obtained with an Laser Doppler Velocimeter (LDV) system, on the upper surface, near the leading edge of an oscillating airfoil undergoing compressible dynamic stall. In particular, the effect of oscillation amplitude has been studied. The results show that at an oscillation amplitude of 10 degrees, a separation bubble forms, that eventually

bursts on the upstroke, well beyond the static stall angle. At 2 degrees amplitude, the bubble forms on the upstroke, but dynamic stall occurs on the downstroke. The results reveal new flow physics and the data sets serve as valuable quantitative information for validation of unsteady flow codes at transitional Reynolds numbers. The maximum velocity seen in the flow is about 1.6 times the free stream value and it occurs slightly downstream of the suction peak location. Some of the measurement difficulties are also discussed. Author (Herner)

A95-60192* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.

AERODYNAMIC INTERACTIONS BETWEEN A ROTOR AND WING IN HOVER

FORT F. FELKER NASA. Ames Research Center, Moffett Field, CA, US and JEFFREY S. LIGHT NASA. Ames Research Center, Moffett Field, CA, US Journal of the American Helicopter Society 2 Jun. 1986 p. 53-61 (HTN-94-00714) Copyright

An experimental investigation of rotor/wing aerodynamic interactions in hover is described. The investigation consisted of both a large-scale and a small-scale test. A 0.658-scale V-22 rotor and wing was used in the large-scale test. Wing download, wing surface pressure, rotor performance, and rotor downwash data from the large-scale test are presented. A small-scale experiment was conducted to determine how changes in the rotor/wing geometry affected the aerodynamic interactions. These geometry variations included the distance between the rotor and wing, wing incidence angle, wing flap angle, rotor rotation direction, and configurations both with the rotor axis at the tip of the wing (tilt rotor configuration) and with the rotor axis at the center of the wing (compound helicopter configuration). Author (Herner)

A95-60193* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.

A STUDY OF COMPRESSIBILITY EFFECTS ON DYNAMIC STALL OF RAPIDLY PITCHING AIRFOILS

LAWRENCE W. CARR NASA. Ames Research Center, Moffett Field, CA, US and M. S. CHANDRASEKHARA NASA Joint Institute for Aeronautics, Monterey, CA, US Computer Physics Communications (ISSN 0010-4655) vol. 65 1991 p. 62-68 (Contracts MIPR-AR0-137-86; AFOSR-MIPR-88-0010) (HTN-94-00715) Copyright

Results of recent experimental studies into the effect of compressibility on dynamic stall of oscillating airfoils are reviewed. Stroboscopic schlieren images of the strongly unsteady flow field are presented, showing the development of the dynamic stall vortex, and its progression down the airfoil. The effect of varying free-stream Mach number and frequency of oscillation of the airfoil are demonstrated, and examples of local supersonic flow are presented, including the presence of a shock near the leading edge of the airfoil.

N95-10028* National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.

EFFECT OF LEADING- AND TRAILING-EDGE FLAPS ON CLIPPED DELTA WINGS WITH AND WITHOUT WING CAMBER AT SUPERSONIC SPEEDS

GLORIA HERNANDEZ, RICHARD M. WOOD, and PETER F. COVELL May 1994 104 p (Contract RTOP 505-59-30-01) (NASA-TM-4542; L-17272; NAS 1.15:4542) Avail: CASI HC A06/MF A02

An experimental investigation of the aerodynamic characteristics of thin, moderately swept fighter wings has been conducted to evaluate the effect of camber and twist on the effectiveness of leading- and trailing-edge flaps at supersonic speeds in the Langley Unitary Plan Wind Tunnel. The study geometry consisted of a generic fuselage with camber typical of advanced fighter designs without inlets, canopy, or vertical tail. The model was tested with two wing configurations: an uncambered (flat) wing and a cambered and twisted wing. Each wing had an identical clipped delta planform with an inboard leading edge swept back 65 deg and an outboard leading edge swept back 50 deg.

02 AERODYNAMICS

The trailing edge was swept forward 25 deg. The leading-edge flaps were deflected 4 deg to 15 deg, and the trailing-edge flaps were deflected from -30 deg to 10 deg. Longitudinal force and moment data were obtained at Mach numbers of 1.60, 1.80, 2.00, and 2.16 for an angle-of-attack range 4 deg to 20 deg at a Reynolds number of 2.16×10^6 (exp 6) per foot and for an angle-of-attack range 4 deg to 20 deg at a Reynolds number of 2.0×10^6 (exp 6) per foot. Vapor screen, tuft, and oil flow visualization data are also included.

Author (revised)

N95-10029* National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.

EFFECT OF PASSIVE VENTING ON STATIC PRESSURE DISTRIBUTIONS IN CAVITIES AT SUBSONIC AND TRANSONIC SPEEDS (Diskette Supplement)

ROBERT L. STALLINGS, JR. (Lockheed Engineering and Sciences Co., Hampton, VA.), ELIZABETH B. PLENTOVICH, MAUREEN B. TRACY, and MICHAEL J. HEMSCH Jun. 1994 179 p Diskette supplement: 3.5-inch DSHD A complete set of tabulated pressure data is presented both in hard copy and on a floppy disk supplement (Contract RTOP 505-68-70-08)

(NASA-TM-4549; L-17299; NAS 1.15:4549) Avail: CASI Set A11 (HC,DK)

The passive venting techniques for shallow cavities that were investigated consisted of (1) porous floors, (2) slot vents at each end of solid floors, (3) slot vents at each end of porous floors, and (4) pipe vents on solid floors. For deep cavities, passive venting techniques that were investigated consisted of (1) lip vents at the outer edges of the front and rear walls of a cavity with a solid floor and (2) lip vents at the outer edges of the front and rear walls of a cavity with a porous floor. The cavity passive venting models were mounted in a flat plate model and were tested at Mach numbers from 0.20 to 0.95. The shallow cavities had lengths of 32.16 and 42.00 in. and a depth of 2.40 in., resulting in cavity length-to-depth ratios (l/h) of 13.40 and 17.50, respectively. The deep cavity had a length of 32.16 in. and a depth of 4.80 in. ($l/h = 6.70$). All cavities had a width of 9.60 in. Results from the test show that the porous floor and the porous floor combined with slot vents had the greatest effect on the shallow cavity pressure distributions and resulted in distributions that were representative of deeper cavities. The lip vents had little effect on the pressure distributions for the deep cavity with solid or porous floors for most of the test range of Mach number.

Author (revised)

N95-10129* National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.

TWO-DIMENSIONAL CONVERGING-DIVERGING RIPPLED NOZZLES AT TRANSONIC SPEEDS

JOHN R. CARLSON and SCOTT C. ASBURY Jul. 1994 108 p

(Contract RTOP 505-62-30-01)
(NASA-TP-3440; L-17265; NAS 1.60:3440) Avail: CASI HC A06/MF A02

An experimental investigation was performed in the Langley 16-Foot Transonic tunnel to determine the effects of external and internal flap rippling on the aerodynamics of a nonaxisymmetric nozzle. Data were obtained at several Mach numbers from static conditions to 1.2 over a range of nozzle pressure ratios. Nozzles with chordal boattail angles of 10, 20, and 30 degrees, with and without surface rippling, were tested. No effect on discharge coefficient due to surface rippling was observed. Internal thrust losses due to surface rippling were measured and attributed to a combination of additional internal skin friction and shock losses. External nozzle drag for the baseline configurations were generally less than that for the rippled configurations at all free-stream Mach numbers tested. The difference between the baseline and rippled nozzle drag levels generally increased with increasing boat tail angle. The thrust-minus-drag level for each rippled nozzle configuration was less than

the equivalent baseline configuration for each Mach number at the design nozzle pressure ratio.

N95-10131* MCAT Inst., San Jose, CA.

INSTABILITIES ORIGINATING FROM SUCTION HOLES USED FOR LAMINAR FLOW CONTROL (LFC) Progress Report

JONATHAN H. WATMUFF Jul. 1994 24 p Original contains color illustrations

(Contract NCC2-698)

(NASA-CR-196395; NAS 1.26:196395; MCAT-94-23) Avail: CASI HC A03/MF A01; 4 functional color pages

A small-scale wind tunnel previously used for turbulent boundary layer studies has been modified for experiments in laminar flow control. The facility incorporates suction through interchangeable porous test surfaces which are used to stabilize the boundary layer and delay transition to turbulent flow. The thin porous test surfaces are supported by a baffled plenum chamber box which also acts to gather the flow through the surface into tubes which are routed to a high pressure fan. An elliptic leading edge is attached to the assembly to establish a new layer on the test plate. A slot is used to remove the test section flow below the leading edge. The test section was lengthened and fitted with a new ceiling. Substantial modifications were also made to the 3D probe traverse. Detailed studies have been made using isolated holes to explore the underlying instability mechanisms. The suction is perturbed harmonically and data are averaged on the basis of the phase of the disturbance. Conditions corresponding to strong suction and without suction have been studied. In both cases, 3D contour surfaces in the vicinity of the hole show highly three-dimensional T-S waves that fan out away from the hole with streamwise distance. With suction, the perturbations on the centerline are much stronger and decay less rapidly, while the far field is similar to the case without suction. Downstream the contour surfaces of the bow-shaped TS waves develop spanwise irregularities which eventually form into clumps. The contours remain smooth when suction is not applied. Even without suction, the harmonic point source is challenging for CFD; e.g. DNS has been used for streamwise growth. With suction, grid resources are consumed by the hole and this makes DNS even more expensive. Limited DNS results so far indicate that the vortices which emanate from suction holes appear to be stable. The spanwise clumping observed in the experiment is evidence of a secondary instability that could be associated with suction vortices. A typical porous surface for LFC consists of 0.002 inch diameter holes with 0.020 inch grid spacing L , which is too small to resolve disturbances. A 20:1 scale porous test surface has been machined for improved spatial resolution while the L/d is still representative of flight conditions. Designers of porous surfaces use Goldsmith's criterion to minimize crossstream interaction. However nothing is known about the streamwise interactions. Results using two holes, aligned but displaced in the streamwise direction, indicate that partial TS wave cancellation is possible, depending on the hole spacing and disturbance frequency. Using DNS for streamwise interaction studies will be prohibitively expensive if linear superposition cannot be used for the multiple holes.

Author (revised)

N95-10135 National Aerospace Lab., Tokyo (Japan).

AEROELASTIC TAILORING RESEARCH

J. NAKAMICHI, H. EJIRI, T. KIKUCHI, M. MINEGISHI, and T. SOTOZAKI 1993 15 p In JAPANESE See also AD-B064940 (PB94-180031; NAL/TR-1208) Avail: Issuing Activity (National Technical Information Service (NTIS))

Research on aeroelastic tailoring at NAL is presented. Flutter boundaries for an optimized forward swept wing have been experimentally verified at angles of attack of 0 and 2 degrees (which is the design point) in the transonic range. It was found that two different mode flutters and a divergence occur at almost the same dynamic pressure for the optimized forward swept wing. The aeroelastic behavior of the optimized forward swept wing is investigated and is compared with that of parametric studies performed previously.

NTIS

N95-10136 National Aerospace Lab., Tokyo (Japan).
COMPUTATIONS OF UNSTEADY AERODYNAMIC LOADS AROUND OSCILLATING WINGS. PART 1: FORMULATION
 J. NAKAMICHI 1993 25 p In JAPANESE See also PB94-180056

(PB94-180049; NAL/TR-1202-PT-1) Avail: Issuing Activity (National Technical Information Service (NTIS))

In the field of aeroelasticity, inviscid unsteady aerodynamics have traditionally been used to predict aeroelastic phenomena. In the transonic region, however, it has been difficult to predict unstable boundaries even for classical flutter. Recently, the authors have frequently encountered nonclassical flutter which is caused by shock-induced separations on the wing surface. To analyze such nonclassical aeroelastic phenomena of aircraft wings which are caused by air viscosity (i.e., stall flutter, buzz, and buffeting), a computer code was developed which is capable of solving unsteady Navier-Stokes equations around oscillating airfoils/wings. The code is based on the Beam-Warming ADI method combined with a dynamic grid system. In Part 1, the formulation of unsteady aerodynamics calculation is given and a dynamic grid model is presented. The theory and the finite difference discretization are summarized. NTIS

N95-10137 National Aerospace Lab., Tokyo (Japan).
COMPUTATIONS OF UNSTEADY AERODYNAMIC LOADS AROUND OSCILLATING WINGS. PART 2: COMPUTED RESULTS AND DISCUSSIONS
 J. NAKAMICHI 1993 39 p In JAPANESE See also PB94-180049

(PB94-180056; NAL/TR-1203-PT-2) Avail: Issuing Activity (National Technical Information Service (NTIS))

In the field of aeroelasticity, inviscid unsteady aerodynamics have traditionally been used to predict aeroelastic phenomena. In the transonic region, however, it has been difficult to predict unstable boundaries even for classical flutter. Recently, the authors have frequently encountered nonclassical flutter which is caused by shock-induced separations on the wing surface. To analyze such nonclassical aeroelastic phenomena of aircraft wings which are caused by air viscosity (i.e., stall flutter, buzz, and buffeting), a computer code was developed which is capable of solving unsteady Navier-Stokes equations around oscillating airfoils/wings. The code is based on the Beam-Warming ADI method combined with a dynamic grid system. In Part 2, 2D and 3D computed results are given, demonstrating the feasible range of the code. Additional problems are also pointed out which may be incorporated into future computer codes for unsteady aerodynamics around oscillating airfoils/wings. NTIS

N95-10148*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
EFFECTS OF A FORWARD-SWEPT FRONT ROTOR ON THE FLOWFIELD OF A COUNTERROTATION PROPELLER
 M. NALLASAMY (NYMA, Inc., Brook Park, OH.) and GARY G. POBOY Aug. 1994 19 p Presented at the 30th Joint Propulsion Conference, Indianapolis, IN, 27-29 Jun. 1994; sponsored by AIAA, ASME, SAE, and ASEE
 (Contracts NAS3-27186; RTOP 538-03-11)
 (NASA-TM-106671; E-8994; NAS 1.15:106671; AIAA PAPER 94-2694) Avail: CASI HC A03/MF A01; 6 functional color pages

The effects of a forward-swept front rotor on the flowfield of a counterrotation model propeller at takeoff conditions at zero degree angle of attack are studied by solving the unsteady three-dimensional Euler equations. The configuration considered is an uneven blade count counterrotation model with twelve forward-swept blades on the fore rotor and ten aft-swept blades on the aft rotor. The flowfield is compared with that of a reference aft-swept counterrotation geometry and Laser Doppler Velocimeter (LDV) measurements. At the operating conditions considered, the forward-swept blade experiences a higher tip loading and produces a stronger tip vortex compared to the aft-swept blade, consistent with the LDV and acoustic measurements. Neither the solution nor the LDV data indicated the formation of a leading edge vortex. The predicted radial distribution of the circumferentially averaged axial velocity at the measurement station agreed very closely with

LDV data, while crossflow velocities showed poor agreement. The discrepancy between prediction and LDV data of tangential and radial velocities is due in part to the insufficient mesh resolution in the region between the rotors and in the tip region to track the tip vortex. The vortex is diffused by the time it arrives at the measurement station. The uneven blade count configuration requires the solution to be carried out for six blade passages of the fore rotor and five passages of the aft rotor, thus making grid refinement prohibitive. Author

N95-10226# Sandia National Labs., Albuquerque, NM.
NAVIER-STOKES SIMULATIONS OF WECS AIRFOIL FLOWFIELDS

G. F. HOMICZ 1994 10 p Presented at the American Wind Energy Association Annual Conference and Exhibition, Minneapolis, MN, 9-13 May 1994

(Contract DE-AC04-94AL-85000)

(DE94-013341; SAND-93-4037C; CONF-940548-3) Avail: CASI HC A02/MF A01

Sandia National Laboratories has initiated an effort to apply computational fluid dynamics (CFD) to the study of wind energy conversion systems (WECS) aerodynamics. Preliminary calculations are presented for the flow past a SAND 0018/50 airfoil. The flow solver used is F3D, an implicit, finite-difference code which solves the thin-layer Navier-Stokes equations. Two dimensional steady-state calculations are presented at various angles of attack, alpha. Sectional lift and drag coefficient, as well as surface pressure distributions, are compared with wind tunnel data, and exhibit reasonable agreement at low to moderate angles of attack. At high alpha, where the airfoil is stalled, a converged solution to the steady-state equations could not be obtained. The flowfield continued to change with successive iterations, which is consistent with the fact that the actual flow is inherently transient, and requires the solution of the full unsteady form of the equations. DOE

N95-10467 Wright Lab., Wright-Patterson AFB, OH. Aero Propulsion and Power Directorate.

NUMERICAL STUDY OF MIXING IN A HIGH AND LOW ENTHALPY SUPERSONIC TEST FACILITY
 BALU SEKAR, J. M. DONBAR, and A. S. NEJAD In JHU, 30th JANNAF Combustion Subcommittee Meeting, Volume 2 p 103-120 Nov. 1993

Avail: CPIA, 10630 Little Patuxent Pkwy., Suite 202, Columbia, MD 21044-3200 HC

This study compares in-house experimental results of coaxial helium injection from a strut into a Mach 2.0 flow with numerical results derived from the three dimensional, Navier-Stokes, finite volume, upwind code GASP. Of most interest is the data related to mixing and combustion in supersonic flows. Consequently, the major emphasis of both this experimental and numerical investigation is in obtaining detailed velocity profiles and concentration measurements in the region immediately downstream of the injector. Experimentally, the concentration measurements were made using Acetone-PLIF. The numerical results include the facility nozzle solution starting from the subsonic portion, the throat area, subsequent expansion in the supersonic portion, and, further downstream, the axial injection of helium for the mixing studies behind the splitter plate which also acts as a rearward facing step for flame stabilization. The computations predicted the essential features of the flow and the experimental measurements were compared with the numerical results for CFD code validation. In addition, the effect of air stagnation temperature on the predicted mixing characteristics, keeping the other parameters of the flow constant, has been studied numerically for helium/air mixing and H2/air mixing. It is observed for flows with higher freestream enthalpies that the tendency of the jet to mix with the freestream appears to be enhanced only slightly and the jet penetration appears to be increased by a similar amount. Author

N95-10556* National Aeronautics and Space Administration, Washington, DC.
SCIENTIFIC BALLOONS (Videotape)
 Dec. 1991 Videotape: 3 min. 38 sec. playing time

02 AERODYNAMICS

(NASA-TM-109907; NONP-NASA-VT-94-23149) Avail: CASI VHS A01/BETA A22

This video discusses how NASA uses large helium-filled balloons to take payloads up 25 miles to the edge of space to gather data. Balloons provide a cost effective approach to reach these heights. CASI

N95-10739* National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.

THE NASA LANGLEY 8-FOOT TRANSONIC PRESSURE TUNNEL CALIBRATION

CUYLER W. BROOKS, JR., CHARLES D. HARRIS, and PATRICIA G. REAGON Aug. 1994 71 p
(Contract RTOP 505-59-10-30)

(NASA-TP-3437; L-17322; NAS 1.60:3437) Avail: CASI HC A04/MF A01

The NASA Langley 8-Foot Transonic Pressure Tunnel is a continuous-flow, variable-pressure wind tunnel with control capability to independently vary Mach number, stagnation pressure, stagnation temperature, and humidity. The top and bottom walls of the test section are axially slotted to permit continuous variation of the test section Mach number from 0.2 to 1.2, the slot-width contour provides a gradient-free test section 50 in. long for Mach numbers equal to or greater than 1.0 and 100 in. long for Mach numbers less than 1.0. The stagnation pressure may be varied from 0.25 to 2.0 atm. The tunnel test section has been recalibrated to determine the relationship between the free-stream Mach number and the test chamber reference Mach number. The hardware was the same as that of an earlier calibration in 1972 but the pressure measurement instrumentation available for the recalibration was about an order of magnitude more precise. The principal result of the recalibration was a slightly different schedule of reentry flap settings for Mach numbers from 0.80 to 1.05 than that determined during the 1972 calibration. Detailed tunnel contraction geometry, test section geometry, and limited test section wall boundary layer data are presented. Author

N95-10820* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.

A FULL NAVIER-STOKES ANALYSIS OF SUBSONIC DIFFUSER OF A BIFURCATED 70/30 SUPERSONIC INLET FOR HIGH SPEED CIVIL TRANSPORT APPLICATION

KAMLESH KAPOOR, BERNHARD H. ANDERSON, and ROBERT J. SHAW Jul. 1994 14 p Original contains color illustrations
(Contract RTOP 537-02-23)

(NASA-TM-106637; E-8939; NAS 1.15:106637) Avail: CASI HC A03/MF A01; 3 functional color pages

A full Navier-Stokes analysis was performed to evaluate the performance of the subsonic diffuser of a NASA Lewis Research Center 70/30 mixed-compression bifurcated supersonic inlet for high speed civil transport application. The PARC3D code was used in the present study. The computations were also performed when approximately 2.5 percent of the engine mass flow was allowed to bypass through the engine bypass doors. The computational results were compared with the available experimental data which consisted of detailed Mach number and total pressure distribution along the entire length of the subsonic diffuser. The total pressure recovery, flow distortion, and crossflow velocity at the engine face were also calculated. The computed surface ramp and cowl pressure distributions were compared with experiments. Overall, the computational results compared well with experimental data. The present CFD analysis demonstrated that the bypass flow improves the total pressure recovery and lessens flow distortions at the engine face. Author (revised)

N95-10847* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.

COMPUTATIONAL FLUID DYNAMICS USES IN FLUID DYNAMICS/AERODYNAMICS EDUCATION

TERRY L. HOLST Jul. 1994 13 p

(Contract RTOP 509-10-00)
(NASA-TM-108834; A-94105; NAS 1.15:108834) Avail: CASI HC A03/

MF A01

The field of computational fluid dynamics (CFD) has advanced to the point where it can now be used for the purpose of fluid dynamics physics education. Because of the tremendous wealth of information available from numerical simulation, certain fundamental concepts can be efficiently communicated using an interactive graphical interrogation of the appropriate numerical simulation data base. In other situations, a large amount of aerodynamic information can be communicated to the student by interactive use of simple CFD tools on a workstation or even in a personal computer environment. The emphasis in this presentation is to discuss ideas for how this process might be implemented. Specific examples, taken from previous publications, will be used to highlight the presentation. Author

N95-10848* Institute for Computer Applications in Science and Engineering, Hampton, VA.

AGGLOMERATION MULTIGRID FOR VISCOUS TURBULENT FLOWS Final Report

D. J. MAVRIPLIS and V. VENKATKRISHNAN Jul. 1994 30 p Submitted for publication

(Contracts NAS1-19480; RTOP 505-90-52-01)
(NASA-CR-194953; NAS 1.26:194953; ICASE-94-62) Avail: CASI HC A03/MF A01

Agglomeration multigrid, which has been demonstrated as an efficient and automatic technique for the solution of the Euler equations on unstructured meshes, is extended to viscous turbulent flows. For diffusion terms, coarse grid discretizations are not possible, and more accurate grid transfer operators are required as well. A Galerkin coarse grid operator construction and an implicit prolongation operator are proposed. Their suitability is evaluated by examining their effect on the solution of Laplace's equation. The resulting strategy is employed to solve the Reynolds-averaged Navier-Stokes equations for aerodynamic flows. Convergence rates comparable to those obtained by a previously developed non-nested mesh multigrid approach are demonstrated, and suggestions for further improvements are given. Author

N95-10853* Toledo Univ., OH.

MODELING IMPROVEMENTS AND USERS MANUAL FOR AXIAL-FLOW TURBINE OFF-DESIGN COMPUTER CODE AXOD

Final Report

ARTHUR J. GLASSMAN Aug. 1994 34 p

(Contracts NAG3-1165; RTOP 505-69-50)
(NASA-CR-195370; E-9052; NAS 1.26:195370) Avail: CASI HC A03/MF A01

An axial-flow turbine off-design performance computer code used for preliminary studies of gas turbine systems was modified and calibrated based on the experimental performance of large aircraft-type turbines. The flow- and loss-model modifications and calibrations are presented in this report. Comparisons are made between computed performances and experimental data for seven turbines over wide ranges of speed and pressure ratio. This report also serves as the users manual for the revised code, which is named AXOD. Author

N95-10858* National Aeronautics and Space Administration. Hugh L. Dryden Flight Research Facility, Edwards, CA.

FLOW-VISUALIZATION STUDY OF THE X-29A AIRCRAFT AT HIGH ANGLES OF ATTACK USING A 1/48-SCALE MODEL

STACEY J. COTTON (Air Force Flight Test Center, Edwards AFB, CA.) and LISA J. BJARKE Aug. 1994 31 p Original contains color illustrations

(Contract RTOP 533-02-38)
(NASA-TM-104268; H-1918; NAS 1.15:104268) Avail: CASI HC A03/MF A01; 17 functional color pages

A water-tunnel study on a 1/48-scale model of the X-29A aircraft was performed at the NASA Dryden Flow Visualization Facility. The water-tunnel test enhanced the results of the X-29A flight tests by providing flow-visualization data for comparison and insights into the aerodynamic characteristics of the aircraft. The model was placed in the water tunnel at angles of attack of 20 to 55 deg. and with angles of sideslip from 0 to 5 deg. In general, flow-visualization techniques

provided useful information on vortex formation, separation, and breakdown and their role in yaw asymmetries and tail buffeting. Asymmetric forebody vortices were observed at angles of attack greater than 30 deg. with 0 deg. sideslip and greater than 20 deg. with 5 deg. sideslip. While the asymmetric flows observed in the water tunnel did not agree fully with the flight data, they did show some of the same trends. In addition, the flow visualization indicated that the interaction of forebody vortices and the wing wake at angles of attack between 20 and 35 deg. may cause vertical-tail buffeting observed in flight.

N95-10940* MCAT Inst., San Jose, CA.
NUMERICAL SIMULATION OF THE FLOW ABOUT THE F-18 HARV AT HIGH ANGLE OF ATTACK Annual Report
 SCOTT M. MURMAN (MCAT Inst., Moffett Field, CA.) Jul. 1994

31 p
 (Contract NCC2-729)
 (NASA-CR-196396; NAS 1.26:196396; MCAT-94-11) Avail: CASI HC A03/MF A01

This report summarizes research done over the past two years as part of NASA Grant NCC 2-729. This research has been aimed at validating numerical methods for computing the flow about the complete F-18 HARV at $\alpha = 30$ deg and $\alpha = 45$ deg. At 30 deg angle of attack, the flow about the F-18 is dominated by the formation, and subsequent breakdown, of strong vortices over the wing leading-edge extensions (LEX). As the angle of attack is increased to $\alpha = 45$ deg, the fuselage forebody of the F-18 contains significant laminar and transitional regions which are not present at $\alpha = 30$ deg. Further, the flow over the LEX at $\alpha = 45$ deg is dominated by an unsteady shedding in time, rather than strong coherent vortices. This complex physics, combined with the complex geometry of a full aircraft configuration, provides a challenge for current computational fluid dynamics (CFD) techniques. The following sections present the numerical method and grid generation scheme that was used, a review of prior research done to numerically model the F-18 HARV, and a discussion of the current research. The current research is broken into two main topics: the effect of engine-inlet mass-flow rate on the F-18 vortex breakdown position, and the results using a refined F-18 computational model to compute the flow at $\alpha = 30$ deg and $\alpha = 45$ deg. Author

N95-11157* National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL.
A PROGRAMMABLE HEATER CONTROL CIRCUIT FOR SPACECRAFT Final Report

D. D. NGUYEN, J. W. OWEN, D. A. SMITH, and W. J. LEWTER Jun. 1994 49 p
 (Contract PROJ. 90-19)

(NASA-TM-108459; NAS 1.15:108459) Avail: CASI HC A03/MF A01
 Spacecraft thermal control is accomplished for many components through use of multilayer insulation systems, electrical heaters, and radiator systems. The heaters are commanded to maintain component temperatures within design specifications. The programmable heater control circuit (PHCC) was designed to obtain an effective and efficient means of spacecraft thermal control. The hybrid circuit provides use of control instrumentation as temperature data, available to the spacecraft central data system, reprogrammable capability of the local microprocessor during the spacecraft's mission, and the elimination of significant spacecraft wiring. The hybrid integrated circuit has a temperature sensing and conditioning circuit, a microprocessor, and a heater power and control circuit. The device is miniature and housed in a volume which allows physical integration with the component to be controlled. Applications might include alternate battery-powered logic-circuit configurations. A prototype unit with appropriate physical and functional interfaces was procured for testing. The physical functionality and the feasibility of fabrication of the hybrid integrated circuit were successfully

verified. The remaining work to develop a flight-qualified device includes fabrication and testing of a Mil-certified part. An option for completing the PHCC flight qualification testing is to enter into a joint venture with industry.

N95-11158* National Aeronautics and Space Administration. Hugh L. Dryden Flight Research Facility, Edwards, CA.
TRANSONIC FLIGHT TEST OF A LAMINAR FLOW LEADING EDGE WITH SURFACE EXCRESCENCES
 FANNY A. ZUNIGA, AARON DRAKE, ROBERT A. KENNELLY, JR., DENNIS J. KOGA, and RUSSELL V. WESTPHAL Washington Aug. 1994 14 p Presented at the 6th Biennial Flight Test Conference, Colorado Springs, CO, 20-23 Jun. 1994 Original contains color illustrations

(Contract RTOP 505-59-10)
 (NASA-TM-4597; H-1994; NAS 1.15:4597; AIAA PAPER 94-2142) Copyright Avail: CASI HC A03/MF A01; 1 functional color page

A flight experiment, conducted at NASA Dryden Flight Research Center, investigated the effects of surface excrescences, specifically gaps and steps, on boundary-layer transition in the vicinity of a leading edge at transonic flight conditions. A natural laminar flow leading-edge model was designed for this experiment with a spanwise slot manufactured into the leading-edge model to simulate gaps and steps like those present at skin joints of small transonic aircraft wings. The leading-edge model was flown with the flight test fixture, a low-aspect ratio fin mounted beneath an F-104G aircraft. Test points were obtained over a unit Reynolds number range of 1.5 to 2.5 million/ft and a Mach number range of 0.5 to 0.8. Results for a smooth surface showed that laminar flow extended to approximately 12 in. behind the leading edge at Mach number 0.7 over a unit Reynolds number range of 1.5 to 2.0 million/ft. The maximum size of the gap-and-step configuration over which laminar flow was maintained consisted of two 0.06-in. gaps with a 0.02-in. step at a unit Reynolds number of 1.5 million/ft. Author

N95-11179* National Aerospace Lab., Amsterdam (Netherlands).
REANALYSIS OF EUROPEAN FLIGHT LOADS DATA Final Report

J. B. DEJONGE, P. A. HOL, and P. A. VANGELDER May 1994 78 p
 (AD-A282052; NLR-TP-93535L; DOT/FAA/CT-94/21) Avail: CASI HC A05/MF A01

The principle tasks of this research effort were to identify and acquire existing European flight loads data, to develop a unified procedure to reduce the acceleration data into gust statistics, and to reduce and analyze the data. Three data bases containing information on center of gravity acceleration experience of commercial transport aircraft were obtained and analyzed. A very large database containing data on aircraft operated by British Airways was obtained from the Office National d'etudes et de recherches aérospatiales in France. A database kept at National Aerospace Laboratory, containing information on Boeing B-747 aircraft operated by KLM, SAS, and Swissair, was also used. The third database contains data collected several years ago by the Royal Aircraft Establishment for a wide variety of mainly piston-engine aircraft. The size of the combined database corresponds to 870,000 flights, 1.6 billion kilometers, and 2 million flight hours. A unified procedure was developed to reduce the data based on both discrete and continuous gust approaches. The results obtained show a considerably lower gust experience at higher altitude than predicted by currently used statistical models. At low altitudes, these results tended to agree with other statistical data. However, gust exceedance data at altitudes below 2000 feet were incomplete and partially biased by maneuver accelerations. Additional low altitude gust exceedance data are needed. DTIC

N95-11366* MCAT Inst., San Jose, CA.
DEVELOPMENT OF AN UPWIND, FINITE-VOLUME CODE WITH FINITE-RATE CHEMISTRY Annual Report
 GREGORY A. MOLVIK 31 Jul. 1994 126 p Original contains color illustrations

02 AERODYNAMICS

(Contract NCC2-498)
(NASA-CR-196749; NAS 1.26:196749; MCAT-94-01) Avail: CASI HC A07MF A02; 8 functional color pages

Under this grant, two numerical algorithms were developed to predict the flow of viscous, hypersonic, chemically reacting gases over three-dimensional bodies. Both algorithms take advantage of the benefits of upwind differencing, total variation diminishing techniques, and a finite-volume framework, but obtain their solution in two separate manners. The first algorithm is a zonal, time-marching scheme, and is generally used to obtain solutions in the subsonic portions of the flow field. The second algorithm is a much less expensive, space-marching scheme and can be used for the computation of the larger, supersonic portion of the flow field. Both codes compute their interface fluxes with a temporal Riemann solver and the resulting schemes are made fully implicit including the chemical source terms and boundary conditions. Strong coupling is used between the fluid dynamic, chemical, and turbulence equations. These codes have been validated on numerous hypersonic test cases and have provided excellent comparison with existing data.

Author

N95-11367*# MCAT Inst., San Jose, CA.
COMPUTATIONAL ANALYSIS OF FOREBODY TANGENTIAL SLOT BLOWING ON THE HIGH ALPHA RESEARCH VEHICLE
Annual Report, Jan. - Jul. 1994

KEN GEE Jul. 1994 16 p Original contains color illustrations
(Contract NCC2-657)
(NASA-CR-196750; NAS 1.26:196750; MCAT-94-22) Avail: CASI HC A03MF A01; 1 functional color page

Current and future fighter aircraft can maneuver in the high-angle-of-attack flight regime while flying at low subsonic and transonic freestream Mach numbers. However, at any flight speed, the ability of the vertical tails to generate yawing moment is limited in high-angle-of-attack flight. Thus, any system designed to provide the pilot with additional side force and yawing moment must work in both low subsonic and transonic flight. However, previous investigations of the effectiveness of forebody tangential slot blowing in generating the desired control forces and moments have been limited to the low subsonic freestream flow regime. In order to investigate the effectiveness of tangential slot blowing in transonic flight, a computational fluid dynamics analysis was carried out during the grant period. Computational solutions were obtained at three different freestream Mach numbers and at various jet mass flow ratios. All results were obtained using the isolated F/A-18 forebody grid geometry at 30.3 degrees angle of attack. One goal of the research was to determine the effect of freestream Mach number on the effectiveness of forebody tangential slot blowing in generating yawing moment. The second part of the research studied the force onset time lag associated with blowing. The time required for the yawing moment to reach a steady-state value from the onset of blowing may have an impact on the implementation of a pneumatic system on a flight vehicle.

Author

N95-11408*# National Aeronautics and Space Administration. Hugh L. Dryden Flight Research Facility, Edwards, CA.
ON THE USE OF CONTROLS FOR SUBSONIC TRANSPORT PERFORMANCE IMPROVEMENT: OVERVIEW AND FUTURE DIRECTIONS

GLENN GILYARD and MARTIN ESPANA Washington Aug. 1994 18 p Presented at the Atmospheric Flight Mechanics Conference, Scottsdale, AZ, 1-3 Aug. 1994

(Contract RTOP 505-69-10)
(NASA-TM-4605; H-2002; NAS 1.15:4605; AIAA PAPER 94-3515) Copyright Avail: CASI HC A03MF A01

Increasing competition among airline manufacturers and operators has highlighted the issue of aircraft efficiency. Fewer aircraft orders have led to an all-out efficiency improvement effort among the manufacturers to maintain if not increase their share of the shrinking number of aircraft sales. Aircraft efficiency is important in airline profitability and is key if fuel prices increase from their current low. In a continuing effort to improve aircraft efficiency and develop an

optimal performance technology base, NASA Dryden Flight Research Center developed and flight tested an adaptive performance seeking control system to optimize the quasi-steady-state performance of the F-15 aircraft. The demonstrated technology is equally applicable to transport aircraft although with less improvement. NASA Dryden, in transitioning this technology to transport aircraft, is specifically exploring the feasibility of applying adaptive optimal control techniques to performance optimization of redundant control effectors. A simulation evaluation of a preliminary control law optimizes wing-aileron camber for minimum net aircraft drag. Two submodes are evaluated: one to minimize fuel and the other to maximize velocity. This paper covers the status of performance optimization of the current fleet of subsonic transports. Available integrated controls technologies are reviewed to define approaches using active controls. A candidate control law for adaptive performance optimization is presented along with examples of algorithm operation.

N95-11489*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.

POTENTIAL IMPACTS OF ADVANCED AERODYNAMIC TECHNOLOGY ON AIR TRANSPORTATION SYSTEM PRODUCTIVITY

DENNIS M. BUSHNELL, ed. Sep. 1994 200 p Workshop held Hampton, VA, 29 Jun. - 1 Jul. 1993
(Contract RTOP 232-01-04-01)

Summaries of a workshop held at NASA Langley Research Center in 1993 to explore the application of advanced aerodynamics to airport productivity improvement are discussed. Sessions included discussions of terminal area productivity problems and advanced aerodynamic technologies for enhanced high lift and reduced noise, emissions, and wake vortex hazard with emphasis upon advanced aircraft configurations and multidisciplinary solution options. Author

N95-11582*# Hampton Univ., VA. Dept. of Mathematics.

STEADY AND UNSTEADY THREE-DIMENSIONAL TRANSONIC FLOW COMPUTATIONS BY INTEGRAL EQUATION METHOD
Final Technical Report, Sep. 1990 - Aug. 1994

HONG HU Aug. 1994 180 p
(Contract NAG1-1170)

(NASA-CR-196777; NAS 1.26:196777) Avail: CASI HC A09MF A02

This is the final technical report of the research performed under the grant: NAG1-1170, from the National Aeronautics and Space Administration. The report consists of three parts. The first part presents the work on unsteady flows around a zero-thickness wing. The second part presents the work on steady flows around non-zero thickness wings. The third part presents the massively parallel processing implementation and performance analysis of integral equation computations. At the end of the report, publications resulting from this grant are listed and attached.

Author (revised)

N95-10548*# National Aeronautics and Space Administration, Washington, DC.

THE HIGH SPEED RESEARCH PROGRAM (Videotape)

Jun. 1993 Videotape: 1 min. 11 sec. playing time, with sound
(NASA-TM-109869; NONP-NASA-VT-94-23140) Avail: CASI VHS A01/BETA A22

This video highlights the endeavors of NASA and the United States manufacturers to provide technology that will make air travel to Pacific countries more efficient. This video was shown at the 1993 Paris Airshow.

N95-10566*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.

AIRBORNE WINDSHEAR DETECTION AND WARNING SYSTEMS, FIFTH AND FINAL COMBINED

MANUFACTURERS' AND TECHNOLOGISTS' CONFERENCE, PART 1

VICTORE DELNORE, comp. (Lockheed Engineering and Sciences Co., Hampton, VA.) Jul. 1994 445 p Conference held in Hampton,

VA, 28-30 Sep. 1993; cosponsored by FAA Prepared in cooperation with FAA, Washington, DC
(Contract RTOP 505-64-12-01)
(NAS-CP-10139-PT-1; NAS 1.55:10139-PT-1; DOT/FAA/RD-94/14-PT-1) Avail: CASI HC A19/MF A04 The Fifth (and Final)

Combined Manufacturers' and Technologists' Airborne Windshear Review Meeting was hosted jointly by the NASA Langley Research Center (LaRC) and the Federal Aviation Administration (FAA) in Hampton, Virginia, on September 28-30, 1993. The purpose of the meeting was to report on the highly successful windshear experiments conducted by government, academic institutions, and industry; to transfer the results to regulators, manufacturers, and users; and to set initiatives for future aeronautics technology research. The formal sessions covered recent developments in windshear flight testing; windshear modeling, flight management, and ground-based systems; airborne windshear detection systems; certification and regulatory issues; development and applications of sensors for wake vortex detection; and synthetic and enhanced vision systems.

N95-10570*# Massachusetts Inst. of Tech., Lexington. Lincoln Lab. **FUTURE ENHANCEMENTS TO GROUND-BASED MICROBURST DETECTION**

STEVEN D. CAMPBELL, MICHAEL P. MATTHEWS, and TIMOTHY J. DASEY. In NASA. Langley Research Center, Airborne Windshear Detection and Warning Systems. Fifth and Final Combined Manufacturers' and Technologists' Conference, Part 1 p 221-239 Jul. 1994 (Contract F19628-90-C-0002)
Avail: CASI HC A03/MF A04

This set of viewgraphs presents the results of the Cockpit Weather Information (CWI) program at M.I.T. Lincoln Laboratory. The CWI program has been funded through NASA Langley Research Center by the joint NASA/FAA Integrated Airborne Wind Shear Program for the past four years. During this time, over 120 microburst penetrations by research aircraft have been conducted under Terminal Doppler Weather Radar (TDWR) tested radar surveillance at Orlando, FL. The results of these in-situ measurements have been compared with ground-based detection methods. Several valuable insights were gained from this research activity. First, it was found that the current TDWR microburst shapes do not permit accurate characterization of microburst hazard in terms of the F factor hazard index, because they are based on loss value rather than shear. Second, it was found that the horizontal component of the F factor can be accurately estimated from shear, provided compensation is made for the dependence of outflow strength on altitude. Third, it was found that a simple continuity assumption for estimating the vertical component of the F factor yielded poor results. However, further research has shown that downdraft strength is correlated with features aloft detected by the TDWR radar scan strategy. The outcome of the CWI program is to move from the loss-based wind shear detection algorithm used in the TDWR to a shear-based detection scheme as proposed in the Integrated Terminal Weather System (ITWS).
Derived from text

N95-10571*# National Center for Atmospheric Research, Boulder, CO. Research Applications Program.

DETERMINING F-FACTOR USING GROUND-BASED DOPPLER RADAR: VALIDATION AND RESULTS

K. L. ELMORE, E. D. ALBO, and R. K. GOODRICH. In NASA. Langley Research Center, Airborne Windshear Detection and Warning Systems. Fifth and Final Combined Manufacturers' and Technologists' Conference, Part 1 p 241-285 Jul. 1994
Avail: CASI HC A03/MF A04

Using a two-dimensional linear least-squares method applied to Doppler radar data, we test the viability of determining F-factor remotely. The ultimate application of such an algorithm will be supplying real-time F-factor maps, derived from ground-based Doppler radars to air traffic control personnel and pilots. Data from NASA deployments to the MIT/Lincoln Lab TDWR tested radar in Orlando in 1991 and 1992 along with NASA deployments to the NCAR TDWR tested radar in Denver are examined. Preliminary analyses show that the two-dimensional method correlates reasonably well with in situ measurements.

Several effects, independent of the method used, act to reduce the correlation to less than one. These include time differences between radar and aircraft data, vertical misalignment between the aircraft and the radar beam, different spatial resolution scales between aircraft and radar data, inhomogeneous radar beam filling, noise in radar data that eludes filtering, and phase lag between time and space due to low pass filtering of the aircraft data. In the final assessment, it appears that a shear-based F-factor algorithm is preferable to the currently implemented TDWR algorithms which lack any local shear estimates.

Author

N95-10737*# National Aeronautics and Space Administration. Hugh L. Dryden Flight Research Center, Edwards, CA.

THE CRASH OF FLIGHT 232 (Videotape)

24 May 1991 Videotape: 1 hr. 19 min. 50 sec. playing time, in color, with sound
(NASA-TM-104279; NONP-NASA-VT-94-23627) Avail: CASI VHS A01/BETA A22

Captain Al Haynes of United Airlines gives a presentation about the DC-10 he captained that crash landed in Sioux City, Iowa in 1989. DFRG

04

AIRCRAFT COMMUNICATIONS AND NAVIGATION

Includes digital and voice communication with aircraft; air navigation systems (satellite and ground based); and air traffic control.

N95-10846*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.

DESIGN AND FLIGHT EVALUATION OF AN INTEGRATED NAVIGATION AND NEAR-TERRAIN HELICOPTER GUIDANCE SYSTEM FOR NIGHT-TIME AND ADVERSE WEATHER OPERATIONS

HARRY N. SWENSON, RICHARD E. ZELENKA, MUNRO G. DEARING, GORDON H. HARDY, RAYMOND CLARK, TOM DAVIS, GARY AMATRUDO, and ANDRE ZIRKLER Aug. 1994 15 p (Contract RTOP 505-64-36)
(NASA-TM-108837; A-94112; NAS 1.15:108837) Avail: CASI HC A03/MF A01

NASA and the U.S. Army have designed, developed, and flight evaluated a Computer Aiding for Low Altitude Helicopter Flight (CALAHF) guidance system. This system provides guidance to the pilot for near terrain covert helicopter operations. It automates the processing of precision navigation information, helicopter mission requirements, and terrain flight guidance. The automation is presented to the pilot through symbology on a helmet-mounted display. The symbology is a 'pilot-centered' design which preserves pilot flexibility and authority over the CALAHF system's automation. An extensive flight evaluation of the system has been conducted using the U.S. Army's NUH-60 STAR (Systems Testbed for Avionics Research) research helicopter. The evaluations were flown over a multiwaypoint helicopter mission in rugged mountainous terrain, at terrain clearance altitudes from 300 to 125 ft and airspeeds from 40 to 110 knots. The results of these evaluations showed that the pilots could precisely follow the automation symbology while maintaining a high degree of situational awareness.

Author

N95-10240*# Lockheed Aeronautical Systems Co., Marietta, GA.

ADVANCED COMPOSITES STRUCTURAL CONCEPTS AND MATERIALS TECHNOLOGIES FOR PRIMARY AIRCRAFT STRUCTURES: STRUCTURAL RESPONSE AND FAILURE ANALYSIS Final Technical Report, May 1989 - May 1992

WILLIAM J. DORRIS, JOHN W. HAIR, JUI-TIEN HUANG, J. EDWARD INGRAM, and BHARAT M. SHAH Sep. 1992 107 p (Contracts NAS1-18888; RTOP 510-02-13-01) (NASA-CR-4448; NAS 1.26:4448; LG92ER0035) Avail: CASI HC A06/

04 AIRCRAFT COMMUNICATIONS AND NAVIGATION

MF A02

Non-linear analysis methods were adapted and incorporated in a finite element based DIAL code. These methods are necessary to evaluate the global response of a stiffened structure under combined in-plane and out-of-plane loading. These methods include the Arc Length method and target point analysis procedure. A new interface material model was implemented that can model elastic-plastic behavior of the bond adhesive. Direct application of this method is in skin/stiffener interface failure assessment. Addition of the AML (angle minus longitudinal or load) failure procedure and Hasin's failure criteria provides added capability in the failure predictions. Interactive Stiffened Panel Analysis modules were developed as interactive pre- and post-processors. Each module provides the means of performing self-initiated finite elements based analysis of primary structures such as a flat or curved stiffened panel; a corrugated flat sandwich panel; and a curved geodesic fuselage panel. This module brings finite element analysis into the design of composite structures without the requirement for the user to know much about the techniques and procedures needed to actually perform a finite element analysis from scratch. An interactive finite element code was developed to predict bolted joint strength considering material and geometrical non-linearity. The developed method conducts an ultimate strength failure analysis using a set of material degradation models.

Author

N95-10242*# Lockheed Aeronautical Systems Co., Marietta, GA.
ADVANCED COMPOSITES STRUCTURAL CONCEPTS AND MATERIALS TECHNOLOGIES FOR PRIMARY AIRCRAFT STRUCTURES. STRUCTURAL RESPONSE AND FAILURE ANALYSIS: ISPAN MODULES USERS MANUAL Report, May 1989 - May 1992

JOHN W. HAIR, JUI-TEN HUANG, J. EDWARD INGRAM, and BHARAT M. SHAH Sep. 1992 388 p
(Contracts NAS1-18888; RTOP 510-02-13-01)
(NASA-CR-4449; NAS 1.26:4449; LG92ER0036) Avail: CASI HC A17/MF A04

The ISPAN Program (Interactive Stiffened Panel Analysis) is an interactive design tool that is intended to provide a means of performing simple and self contained preliminary analysis of aircraft primary structures made of composite materials. The program combines a series of modules with the finite element code DIAL as its backbone. Four ISPAN Modules were developed and are documented. These include: (1) flat stiffened panel; (2) curved stiffened panel; (3) flat tubular panel; and (4) curved geodesic panel. Users are instructed to input geometric and material properties, load information and types of analysis (linear, bifurcation buckling, or post-buckling) interactively. The program utilizing this information will generate finite element mesh and perform analysis. The output in the form of summary tables of stress or margins of safety, contour plots of loads or stress, and deflected shape plots may be generalized and used to evaluate specific design.

Author

N95-10245*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.

FLY-BY-LIGHT/POWER-BY-WIRE REQUIREMENTS AND TECHNOLOGY WORKSHOP

ROBERT L. BAKER, ed. (Research Triangle Inst., Research Triangle Park, NC.) and FELIX L. PITTS, ed. Sep. 1992 284 p Workshop held in Hampton, VA, 17-19 Mar. 1992
(Contract RTOP 505-64-10-09)

The results of the Fly-By-Light/Power-By-Wire (FBL/PBW) Workshop held on March 17-19, 1992, at the NASA Langley Research Center are presented. The FBL/PBW program is a joint NASA LeRC/LaRC effort to develop the technology base for confident application of integrated FBL/PBW systems to transport aircraft. The objectives of the workshop were to ascertain the FBL/PBW program technical requirements and satisfy the requirements

and needs from the industry viewpoint, provide a forum for presenting and documenting alternative technical approaches which satisfy the requirements, and assess the plan adequacy in accomplishing plan objectives, aims, and technology transfer. Areas addressed were: optical sensor systems, power-by-wire systems, FBL/PBW fault-tolerant architectures, electromagnetic environment assessment, and system integration and demonstration. The workshop consisted of an introductory meeting, a 'keynote' presentation, a series of individual panel sessions covering the above areas, with midway presentations by the panel chairpersons, followed by a final summarizing/integrating session by the individual panels, and a closing plenary session summarizing the results of the workshop.

Author

N95-10316*# Lockheed Aeronautical Systems Co., Marietta, GA. Advanced Structures and Materials Div.

ADVANCED COMPOSITES STRUCTURAL CONCEPTS AND MATERIALS TECHNOLOGIES FOR PRIMARY AIRCRAFT STRUCTURES: DESIGN/MANUFACTURING CONCEPT ASSESSMENT Final Technical Report, May 1989 - May 1992

ROBERT L. CHU, TOM D. BAYHA, HU DAVIS, J. ED INGRAM, and JAY G. SHUKLA Sep. 1992 107 p
(Contracts NAS1-18888; RTOP 510-02-13-01)
(NASA-CR-4447; NAS 1.26:4447; REPT-73-C1) Avail: CASI HC A06/MF A02

Composite Wing and Fuselage Structural Design/Manufacturing Concepts have been developed and evaluated. Trade studies were performed to determine how well the concepts satisfy the program goals of 25 percent cost savings, 40 percent weight savings with aircraft resizing, and 50 percent part count reduction as compared to the aluminum Lockheed L-1011 baseline. The concepts developed using emerging technologies such as large scale resin transfer molding (RTM), automatic tow placed (ATP), braiding, out-of-autoclave and automated manufacturing processes for both thermoset and thermoplastic materials were evaluated for possible application in the design concepts. Trade studies were used to determine which concepts carry into the detailed design development subtask.

Author

N95-10442# Calspan Advanced Technology Center, Buffalo, NY.
EVALUATION OF F-18A APPROACH AND LANDING FLYING QUALITIES USING AN IN-FLIGHT SIMULATOR Final Report ROGERS E. SMITH Feb. 1979 136 p Prepared for NATC, Patuxent River, MD

(Contract F33615-78-C-3602)

(CALSPAN-6241-F-1) Avail: CASI HC A07/MF A02

The landing approach flying qualities of the Navy F-18A aircraft were evaluated using the AFFDL/Calspan variable stability NT-33 aircraft. These evaluations were performed prior to the first flight of the F-18A and were undertaken to identify any flying qualities problems which might compromise first flight safety. Five pilots performed 80 evaluations during the two phases of the simulation program. Phase 1 evaluations of the original flight control system and subsequent modifications concentrated on the effects of time delay on the F-18A landing approach flying qualities. Results showed that the original beta yaw augmentation system was a major problem and that the original lateral command gain was too high. Control system modifications eliminated these problems but the pitch flying qualities remained unsatisfactory. Phase 2 evaluations centered on delay created a major deficiency. Phase 2 evaluations centered on the 30 deg flap first flight configuration and the potential degraded control system modes. Results indicated that the first flight configuration was safe but unsatisfactory due to sluggish pitch response. The first pitch failure mode (DEL) was considered unsafe with the simulated time delay while the remaining failure modes were evaluated as safe but had major flying qualities deficiencies in the context of the pilot rating scale.

Author

N95-10711* National Aeronautics and Space Administration. Hugh L. Dryden Flight Research Center, Edwards, CA.

F-18 HARV PRESENTATION FOR INDUSTRY (Videotape)

1 May 1993 Videotape: 20 min. 57 sec. playing time, in color, with sound
(NASA-TM-104283; NONP-NASA-VT-94-23631) Avail: CASI VHS A01/BETA A22

This video provides a look at some work done by Dryden's F-18 High Alpha Research Vehicle (HARV) in cooperation with the United States Navy and industry.

N95-10715* National Aeronautics and Space Administration. Hugh L. Dryden Flight Research Center, Edwards, CA.

RESEARCH EXCITATION SYSTEM FLIGHT TESTING (Videotape)

30 Mar. 1992 Videotape: 2 min. 35 sec. playing time, in color, with sound
(NASA-TM-104289; NONP-NASA-VT-94-23635) Avail: CASI VHS A01/BETA A22

Excitation system research at Dryden with an F-16XL aircraft is presented.

N95-10716* National Aeronautics and Space Administration. Hugh L. Dryden Flight Research Center, Edwards, CA.

NASA AND THE SR-71: BACK TO THE FUTURE (Videotape)

9 Sep. 1991 Videotape: 4 min. 41 sec. playing time, in color, with sound
(NASA-TM-104290; NONP-NASA-VT-94-23636) Avail: CASI VHS A01/BETA A22

Presented is a musical video salute to NASA's delivery of three SR-71 aircraft for use in flight research.

N95-10740* National Aeronautics and Space Administration. Hugh L. Dryden Flight Research Center, Edwards, CA.

HL-10 DEDICATION CEREMONY (Videotape)

3 Apr. 1990 Videotape: 30 min. 35 sec. playing time, in color, with sound
(NASA-TM-104295; NONP-NASA-VT-94-23640) Avail: CASI VHS A01/BETA A22

The dedication of NASA's HL-10 lifting body, being put on display at NASA Dryden Flight Research Center, is shown.

N95-10741* National Aeronautics and Space Administration. Hugh L. Dryden Flight Research Center, Edwards, CA.

F-104 RESOURCE TAPE (Videotape)

9 Oct. 1992 Videotape: 34 min. playing time, in color, with sound
(NASA-TM-104296; NONP-NASA-VT-94-23641) Avail: CASI VHS A01/BETA A22

This video presents raw, unedited material of Dryden's F-104 aircraft.

N95-10742* National Aeronautics and Space Administration. Hugh L. Dryden Flight Research Center, Edwards, CA.

F-15 835 (HIDEC) RESOURCE TAPE (Videotape)

Feb. 1993 Videotape: 1 hr. 29 min. 59 sec. playing time, in color, with sound
(NASA-TM-104297; NONP-NASA-VT-94-23642) Avail: CASI VHS A01/BETA A22

This video presents raw, unedited material of Dryden's F-15 Highly Integrated Digital Electronic Control (HIDEC) aircraft.

N95-10743* National Aeronautics and Space Administration. Hugh L. Dryden Flight Research Center, Edwards, CA.

F-16XL RESOURCE TAPE (Videotape)

28 Jan. 1993 Videotape: 1 hr. 6 min. 30 sec. playing time, in color, with sound
(NASA-TM-104298; NONP-NASA-VT-94-23643) Avail: CASI VHS A01/BETA A22

This video presents raw, unedited material of Dryden's F-16XL aircraft.

N95-10744* National Aeronautics and Space Administration. Hugh L. Dryden Flight Research Center, Edwards, CA.

F-18 HIGH ALPHA RESEARCH VEHICLE RESOURCE TAPE (Videotape)

11 Aug. 1992 Videotape: 1 hr. 29 min. 30 sec. playing time, in color, with sound
(NASA-TM-104299; NONP-NASA-VT-94-23644) Avail: CASI VHS A01/BETA A22

This video presents raw, unedited material of Dryden's F-18 High Alpha Research Vehicle (HARV) aircraft.

N95-10745* National Aeronautics and Space Administration. Hugh L. Dryden Flight Research Center, Edwards, CA.

X-31 RESOURCE TAPE (Videotape)

23 Aug. 1993 Videotape: 1 hr. 33 min. playing time, in color, with sound
(NASA-TM-104300; NONP-NASA-VT-94-23645) Avail: CASI VHS A01/BETA A22

This video presents raw, unedited material of Dryden's X-31 aircraft.

N95-10751* National Aeronautics and Space Administration. Hugh L. Dryden Flight Research Center, Edwards, CA.

X-31 TAILLESS TESTING (Videotape)

9 Sep. 1994 Videotape: 3 min. 20 sec. playing time, in color, with sound
(NASA-TM-104306; NONP-NASA-VT-94-23651) Avail: CASI VHS A01/BETA A22

This video addresses the NASA Dryden and X-31 International Test Organization (ITO) testbed provided for the Pentagon's 'tailless' and quasi-tailless vehicle configuration testing.

N95-11410*# Planning Research Corp., Edwards, CA.

HIGH-ANGLE-OF-ATTACK YAWING MOMENT ASYMMETRY OF THE X-31 AIRCRAFT FROM FLIGHT TEST

BRENT R. COBLEIGH NASA Sep. 1994 32 p Presented at the Applied Aerodynamics Conference, Colorado Springs, CO, 20-23 Jun. 1994 Sponsored by NASA Dryden Flight Research Center (Contract RTOP 533-02-00)

(NASA-CR-186030; H-2015; NAS 1.26:186030; AIAA PAPER 94-1803) Avail: CASI HC A03/MF A01

Significant yawing moment asymmetries were encountered during the high-angle-of-attack envelope expansion of the two X-31 aircraft. These asymmetries led to position saturations of the thrust vector vanes and trailing-edge flaps during some of the dynamic stability axis rolling maneuvers at high angles of attack. This slowed the high-angle-of-attack envelope expansion and resulted in maneuver restrictions. Several aerodynamic modifications were made to the X-31 forebody with the goal of minimizing the asymmetry. A method for determining the yawing moment asymmetry from flight data was developed and an analysis of the various configuration changes completed. The baseline aircraft were found to have significant asymmetries above 45 deg angle of attack with the largest asymmetry typically occurring around 60 deg angle of attack. Applying symmetrical boundary layer transition strips along the forebody sides increased the magnitude of the asymmetry and widened the angle-of-attack range over which the largest asymmetry acted. Installing longitudinal forebody strakes and rounding the sharp nose of the aircraft caused the yawing moment asymmetry magnitude to be reduced. The transition strips and strakes made the asymmetry characteristic of the aircraft more repeatable than the clean forebody configuration. Although no geometric differences between the aircraft were known, ship 2 consistently had larger yawing moment asymmetries than ship 1.

Author

N95-11465*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.

THE USE OF THE REGIER NUMBER IN THE STRUCTURAL DESIGN WITH FLUTTER CONSTRAINTS

H. J. DUNN and ROBERT V. DOGGETT, JR. Aug. 1994 16 p

(Contract RTOP 505-63-50-06)

04 AIRCRAFT COMMUNICATIONS AND NAVIGATION

(NASA-TM-109128; NAS 1.15:109128) Avail: CASI HC A03/MF A01
This preliminary investigation introduces the use of the Regier number as a flutter constraint criterion for aeroelastic structural optimization. Artificial neural network approximations are used to approximate the flutter criterion requirements as a function of the design Mach number and the parametric variables defining the aspect ratio, center of gravity, taper ratio, mass ratio, and pitch inertia of the wing. The presented approximations are simple enough to be used in the preliminary design stage without a well defined structural model. An example problem for a low-speed, high-aspect-ratio, light-aircraft wing is presented. The example problem is analyzed for the flutter Mach number using doublet lattice aerodynamics and the PK solution method. The use of the Regier number constraint criterion to optimize the example problem for minimum structural mass while maintaining a constant flutter Mach number is demonstrated.
Author (revised)

N95-11595# Naval Postgraduate School, Monterey, CA. AN APPLICATION OF VIRTUAL PROTOTYPING TO THE FLIGHT TEST AND EVALUATION OF AN UNMANNED AIR VEHICLE M.S. Thesis

MARKE T. LAGIER Mar. 1994 79 p
(AD-A281749) Avail: CASI HC A05/MF A01

Virtual Prototyping is an integral part of the ongoing effort to design, test and fly an Unmanned Air vehicle. Current analytical software such as SIMULINK or MATRIX provide powerful design tools with limited graphical output, that require an intuitive knowledge of the underlying dynamic structure. For comprehension, Virtual Prototyping allows an intuitive approach toward understanding the dynamic performance of the model. When the aircraft is flow within visual range of the ground station, a Virtual Prototype display provides the pilot on the ground a close-up view of aircraft response. When the aircraft operates over the horizon, a Virtual Prototype display becomes the only visual link between the pilot and the aircraft. An application of a Virtual Prototype software is presented here with a direct view to implementing the results in the UAV project currently underway at The Naval Postgraduate school. DTIC

N95-11684# Federal Aviation Administration, Washington, DC. Research and Development Service. FAA VERTICAL FLIGHT BIBLIOGRAPHY Final Report, 1962- 1994

ROBERT D. SMITH Aug. 1994 290 p
(DOT/FAA/RD-94/17) Avail: CASI HC A13/MF A03

This bibliography has been assembled as an aid to those who are interested in research, engineering, and development of vertical flight aircraft including helicopters, tiltrotor, and tilting vehicles. The intended audience includes people within the Federal Aviation Administration (FAA), in industry, and in state and local governments. Reports included in this bibliography are FAA documents specifically related, in whole or in part, to vertical flight aircraft. The majority of the documents have been sponsored or authored by the research, engineering, and development elements of the FAA.

Author

07

AIRCRAFT PROPULSION AND POWER

Includes prime propulsion systems and systems components, e.g., gas turbine engines and compressors; and on-board auxiliary power plants for aircraft.

A95-60172* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
**EXPERIMENTAL AND ANALYTICAL INVESTIGATIONS OF
WAVE ENHANCED SUPERSONIC COMBUSTORS**
HENRY G. ADELMAN Eloquent Corp., Palo Alto, CA, US, JEAN-LUC CAMBIER Eloquent Corp., Palo Alto, CA, US, and GENE P. MENEES

NASA. Ames Research Center, Moffett Field, CA, US 10 Jul. 1989
8 p. AIAA/ASME/SAE/ASEE Joint Propulsion Conference, 25th, Monterey, CA, July 10-12, 1989
(AIAA PAPER 89-2787; HTN-94-00692) Copyright

Supersonic combustion ramjet (scramjet) engines rely on rapid mixing and combustion of fuel for good performance. However, both of these processes are relatively slow compared to the residence times in supersonic combustors. Methods of improving the mixing process include subjecting the fuel streams to shock waves and the generation of vortices by spiraling, bifurcating struts. The combustion process can also be enhanced by shock or detonation waves. An oblique shock wave can act as a flameholder by increasing the pressure and temperature of the air-fuel mixture and thereby decreasing the ignition delay. If the oblique shock is sufficiently strong, then the combustion front and the shock wave can couple into a detonation wave. In this case, combustion occurs almost instantaneously in a thin zone behind the wave front. While the existence of standing oblique detonation waves has been proven in computer simulations, the experimental validation is still in progress. Currently, there is an experimental and analytical program at NASA-Ames Research Center to study detonations and other means of wave enhanced supersonic mixing and combustion.

Author (Herner)

A95-60199* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
**EFFECT OF WIND TUNNEL ACOUSTIC MODES ON LINEAR
OSCILLATING CASCADE AERODYNAMICS**
D. H. BUFFUM NASA. Lewis Research Center, Cleveland, OH, US and S. FLEETER Purdue Univ., West Lafayette, IN, US
Journal of Turbomachinery (ISSN 0889-504X) vol. 116 July 1994
p. 513-524

(HTN-94-00760) Copyright

The aerodynamics of a biconvex airfoil cascade oscillating in torsion is investigated using the unsteady aerodynamic influence coefficient technique. For subsonic flow and reduced frequencies as large as 0.9, airfoil surface unsteady pressures resulting from oscillation of one of the airfoils are measured using flush-mounted high-frequency-response pressure transducers. The influence coefficient data are examined in detail and then used to predict the unsteady aerodynamics of a cascade oscillating at various interblade phase angles. These results are correlated with experimental data obtained in the traveling-wave mode of oscillation and linearized analysis predictions. It is found that the unsteady pressure disturbances created by an oscillating airfoil excite wind tunnel acoustic modes, which have detrimental effects on the experimental results. Acoustic treatment is proposed to rectify this problem.

Author (Herner)

N95-10083 National Defence Research Establishment, Stockholm (Sweden). Dept. of Weapon Systems, Effects and Protection
**PROPULSION RESEARCH CONCERNING SFRJ-MOTORS
[FRAMDRIVNINGSTEKNISK FORSKNING FRAEMST
AVSEENDE SOFRAM-MOTORER]**

P. WIMMERSTROEM Feb. 1994 63 p In SWEDISH
(PB94-179520; FOA-C-20963-2.1) Avail: Issuing Activity (National Technical Information Service (NTIS))

This report summarizes activities concerning research on propulsion technology, especially solid fuel ramjet (SFRJ) motors. The effects of spin on the flow field and combustion in 40 mm SFRJ-projectiles is analyzed. Studies concerning mechanical and pyrolysis behavior as well as regression rate of the fuel is shown. A polyurethane and a thermoplastic elastomer have shown sufficient mechanical strength to withstand the stresses during launch. CFD analysis together with advanced measurements in the combustion chamber have shown great potential, especially in determining the characteristics of the flow field and the boundary layer combustion. A computer code for simulating the supersonic internal and external flow field is reported. The code is called CHARISMA and is being used to optimize supersonic wind tunnel nozzles.

NTIS

N95-10153*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.

AN AERODYNAMIC ANALYSIS OF A MIXED FLOW TURBINE
CHAN M. KIM and KESTUTIS C. CIVINSKAS Jul. 1994 15 p
Presented at the 30th Joint Propulsion Conference, Indianapolis, IN, 27-29 Jun. 1994; cosponsored by AIAA, ASME, SAE, and ASEE
(Contracts RTOP 505-62-10; DA PROJ. 1L1-62211-A-47-A)
(NASA-TM-106674; E-9008; NAS 1.15:106674; ARL-JR-572) Avail:
CASI HC A03/MF A01

The aerodynamic performance of a high-work Mixed Flow Turbine (MFT) is computed and compared with experimental data. A three dimensional (3-D) viscous analysis is applied to the single stage MFT geometry with a relatively long upstream transition duct. Predicted vane surface static pressures and circumferentially averaged spanwise quantities at stator and rotor exits agree favorably with data. Compared to the results of axisymmetric flow analysis from design intent, the 3-D computation agrees much better especially in the endwall regions where throughflow prediction fails to assess the loss mechanism properly. Potential sources of performance loss such as tip leakage and secondary flows are also properly captured by the analysis.

Author

N95-10247*# United Technologies Research Center, East Hartford, CT.

COMPUTATIONAL FLUID DYNAMICS STUDY OF THE VARIABLE-PITCH SPLIT-BLADE FAN CONCEPT Final Report

C. E. KEPLER, A. R. ELMQUIST, and R. L. DAVIS Jul. 1992 123 p

(Contract NAS3-25117)
(NASA-CR-189206; NAS 1.26:189206; UTRC-R91-254576-20) Avail:
CASI HC A06/MF A02

A computational fluid dynamics study was conducted to evaluate the feasibility of the variable-pitch split-blade supersonic fan concept. This fan configuration was conceived as a means to enable a supersonic fan to switch from the supersonic through-flow type of operation at high speeds to a conventional fan with subsonic inflow and outflow at low speeds. During this off-design, low-speed mode of operation, the fan would operate with a substantial static pressure rise across the blade row like a conventional transonic fan; the front (variable-pitch) blade would be aligned with the incoming flow, and the aft blade would remain fixed in the position set by the supersonic design conditions. Because of these geometrical features, this low speed configuration would inherently have a large amount of turning and, thereby, would have the potential for a large total pressure increase in a single stage. Such a high-turning blade configuration is prone to flow separation; it was hoped that the channeling of the flow between the blades would act like a slotted wing and help alleviate this problem. A total of 20 blade configurations representing various supersonic and transonic configurations were evaluated using a Navier Stokes CFD program called ADAPTNS because of its adaptive grid features. The flow fields generated by this computational procedure were processed by another data reduction program which calculated average flow properties and simulated fan performance. These results were employed to make quantitative comparisons and evaluations of blade performance. The supersonic split-blade configurations generated performance comparable to a single-blade supersonic, through-flow fan configuration. Simulated rotor total pressure ratios of the order of 2.5 or better were achieved for Mach 2.0 inflow conditions. The corresponding fan efficiencies were approximately 75 percent or better. The transonic split-blade configurations having large amounts of turning were able to generate large amounts of total turning and achieve simulated total pressure ratios of 3.0 or better with subsonic inflow conditions. These configurations had large losses and low fan efficiencies in the 70's percent. They had large separated regions and low velocity wakes. Additional turning and diffusion of this flow in a subsequent stator row would probably be very inefficient. The high total pressure ratios indicated by the rotor performance would be substantially reduced by the stators, and the stage efficiency would be substan-

tially lower. Such performance leaves this dual-mode fan concept less attractive than originally postulated.

Author (revised)

N95-10319*# United Technologies Research Center, East Hartford, CT.

HYDROCARBON-FUELED RAMJET/SCRAMJET TECHNOLOGY PROGRAM, PHASE 2 EXTENSION Final Report, Aug. 1990 - May 1992

IRA W. KAY Jul. 1992 43 p Sponsored in part by Wright Lab. (Contracts NAS1-17794; RTOP 505-62-40-01)
(NASA-CR-189659; NAS 1.26:189659; AD-B167205L) Avail: Issuing Activity

The United Technologies Research Center conducted an experimental program to develop technology for a hydrocarbon-fueled ramjet/scramjet engine for operation at flight Mach numbers up to 7. As part of this program, connected-pipe combustion tests of key pilot and fuel injector components were performed in a variable-geometry two-dimensional test section over a range of combustor entrance conditions simulating the intended flight regime. A supersonic-inlet, air-breathing pilot was developed under the program that also incorporates an external mainstream fuel injector which serves as a primary fuel injection stage for the supersonic combustor. In previous tests at simulated Mach 5.6 flight conditions (comprising a combustor entrance Mach number of 3.0), it was demonstrated that the pilot promoted efficient combustion of gaseous ethylene that was injected into the supersonic mainstream flow as a primary fuel. The idea of using the air-breathing pilot and distributed secondary fuel injection to achieve efficient supersonic combustion of ethylene over a wide range of equivalence ratios was also experimentally demonstrated; during tests with staged fuel injection, high secondary fuel combustion efficiencies were achieved and smooth transitions from fully supersonic to mixed mode (supersonic/subsonic) operation were demonstrated at high overall equivalence ratios. The air-breathing pilot was also shown to effectively isolate the inlet from the combustion process even at the high combustor pressures experienced during mixed mode operation. Most of the testing was done with gaseous ethylene fuel which was chosen to simulate both prevaporized liquid fuels and the gaseous products of the endothermic reaction of liquid hydrocarbon fuels. Limited combustor testing was done with liquid hydrocarbon fuels. Work was done to expand the related data base with liquid hydrocarbon fuels and to investigate the effects of a wider variety of combustor configurations and entrance conditions on component and combustor performance.

Author

N95-10465 Washington Univ., Seattle, WA.

VISUALIZATION OF ONE-DIMENSIONAL FLOW PROCESSES IN A DUAL-MODE SCRAMJET ENGINE

DAVID T. PRATT and W. H. HEISER In JHU, 30th JANNAF Combustion Subcommittee Meeting, Volume 2 p 73-85 Nov. 1993
Avail: CPIA, 10630 Little Patuxent Pkwy., Suite 202, Columbia, MD 21044-3200 HC

In a dual-mode ramjet/scramjet engine, the nature of the interaction between isolator and combustor is markedly different for the two modes. In scramjet mode, thermal occlusion almost always causes flow separation at combustor entry, which in turn causes an oblique shock train to form in the isolator in order to confine the main core flow at combustor entry, which explains the observed 'minimum entropy rise' of supersonic combustors. The size of the separated flow region is greatest near combustor entry, and may exceed one-half of the flow cross-sectional area. Consequently, wall-mounted fuel-injection ramps and axial vorticity generators may not function as designed or as tested in a nonreacting flow. In ramjet mode, choked flow causes a normal shock train to form in the isolator, but the combustor entry flow is stratified rather than separated. For a constant-area combustor, the isolator is only marginally able to contain the normal shock train required for subsonic combustor entry, and any perturbation from this state either disorganizes the thermal throat or unstays the inlet. Consequently, either a variable-area diffuser ('trans-section') or boundary-layer bleed is required for ramjet mode operation in a constant-area combustor. All

07 AIRCRAFT PROPULSION AND POWER

modes of isolator-combustor interaction, as well as mechanisms of transition between ramjet and scramjet modes, are illustrated by an interactive computer graphics display of the pertinent aerothermodynamic processes on both 'I-J-K' (dimensionless enthalpy vs. kinetic energy) coordinates and traditional T-s coordinates. A computer program with this interactive graphics capability has utility for system simulation and preliminary design, as well as combustor performance analysis and interpretation from scramjet wall pressure test data.

Author

N95-10466 University of Southern California, Los Angeles, CA.
PROGRAMMED IGNITION OF METAL COMPOUNDS IN A SCRAMJET

M. GERSTEIN and P. ROY CHOUDHURY In JHU, 30th JANNAF Combustion Subcommittee Meeting, Volume 2 p 87-102 Nov. 1993
Avail: CPIA, 10630 Little Patuxent Pkwy., Suite 202, Columbia, MD 21044-3200 HC

Ignition in a supersonic flow, typical of a scramjet combustor, requires an extremely reactive material. Various investigators at NASA and elsewhere have identified a number of metal compounds which are spontaneously flammable at room temperature and can be used for initiating combustion in a supersonic stream. These metal compounds are hard to handle, some are cryogenic and therefore can not be considered as storable propellants. The present work utilizes the technique of programmed ignition in blends of hydrocarbon and metal compounds. These blends are not cryogenic, some are not spontaneously flammable at room temperature, have higher densities, and require less storage volume. Depending upon the blend, these can be made flammable at a desired distance from the point of injection. A parametric theoretical study of aluminum borohydride, triethyl boron, trimethyl aluminum, and pentaborane as ignition promoting additives and hydrocarbon solvents such as JP-5, propane, butane, and hexane has been performed. Mixture droplets of three different diameters and three different compositions were injected in a 2000 m/s gas stream. Three ambient temperatures (500, 700, and 900 K) were studied.

Author

N95-11005*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
INLET FLOW TEST CALIBRATION FOR A SMALL AXIAL COMPRESSOR FACILITY. PART 1: DESIGN AND EXPERIMENTAL RESULTS

D. P. MILLER and P. S. PRAHST Aug. 1994 20 p Presented at the 30th Joint Propulsion Conference, Indianapolis, IN, 27-29 Jun. 1994; sponsored by AIAA, ASME, SAE, and ASEE (Contracts NAS3-25266; RTOP 505-62-10)
(NASA-TM-106719; E-9085; NAS 1:15:106719; AIAA PAPER 94-2690) Avail: CASI HC A03/MF A01

An axial compressor test rig has been designed for the operation of small turbomachines. The inlet region consisted of a long flowpath region with two series of support struts and a flapped inlet guide vane. A flow test was run to calibrate and determine the source and magnitudes of the loss mechanisms in the inlet for a highly loaded two-stage axial compressor test. Several flow conditions and IGV angle settings were established in which detailed surveys were completed. Boundary layer bleed was also provided along the casing of the inlet behind the support struts and ahead of the IGV. A detailed discussion of the flowpath design along with a summary of the experimental results are provided in Part 1.

Author

N95-11159*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
APPLICATION OF AN INTEGRATED METHODOLOGY FOR PROPULSION AND AIRFRAME CONTROL DESIGN TO A STOVL AIRCRAFT

SANJAY GARG and DUANE MATTERN Sep. 1994 17 p
Presented at the Guidance, Navigation and Control Conference,

Scottsdale, AZ, 1-3 Aug. 1994; sponsored by AIAA (Contracts NAS3-27186; RTOP 505-62-50)
(NASA-TM-106729; E-9104; NAS 1:15:106729; AIAA PAPER 94-3611) Avail: CASI HC A03/MF A01

An advanced methodology for integrated flight propulsion control (IFPC) design for future aircraft, which will use propulsion system generated forces and moments for enhanced maneuver capabilities, is briefly described. This methodology has the potential to address in a systematic manner the coupling between the airframe and the propulsion subsystems typical of such enhanced maneuverability aircraft. Application of the methodology to a short take-off vertical landing (STOVL) aircraft in the landing approach to hover transition flight phase is presented with brief description of the various steps in the IFPC design methodology. The details of the individual steps have been described in previous publications and the objective of this paper is to focus on how the components of the control system designed at each step integrate into the overall IFPC system. The full nonlinear IFPC system was evaluated extensively in nonreal-time simulations as well as piloted simulations. Results from the nonreal-time evaluations are presented in this paper. Lessons learned from this application study are summarized in terms of areas of potential improvements in the STOVL IFPC design as well as identification of technology development areas to enhance the applicability of the proposed design methodology.

Author

08

AIRCRAFT STABILITY AND CONTROL

Includes aircraft handling qualities; piloting; flight controls; and autopilots.

A95-60167* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.

FLIGHT TEST DEVELOPMENT AND EVALUATION OF A KALMAN FILTER STATE ESTIMATOR FOR LOW-ALTITUDE FLIGHT

RICHARD E. ZELENKA NASA. Ames Research Center, Moffett Field, CA, US, ZEE YEE U.S. Army Command/Control and Systems, Ft. Monmouth, NJ, US, and ANDRE ZIRKLER Vtrionics, Inc., Eatontown, NJ, U.S. 13 Sep. 1993 8 p. IEEE Conference on Control Applications, 2nd, Vancouver, Canada, Sep. 13-16, 1993, Paper (HTN-94-00684) Copyright

Flight operations dependent on digitized terrain elevation data for navigational reference or trajectory generation are constrained in minimum flight altitude, due to airborne navigation errors and inaccuracies of the reference terrain elevation data. This limitation is not restrictive in traditional medium-altitude implementations of such databases, such as in unmanned aerial vehicles, missiles, or high-performance, high-speed aircraft. In low-altitude, lower speed terrain hugging helicopter missions, however, such constraints on minimum flight altitudes greatly reduce the effectiveness of their missions and diminish the benefits of employing terrain elevation maps. A Kalman filter state estimator has been developed which blends airborne navigation, stored terrain elevation data, and a radar altimeter in estimating above-ground-level (AGL) altitude. This AGL state estimator was integrated in a near-terrain guidance system aboard a research helicopter and flight tested in moderately rugged terrain over a variety of flight and system conditions. The minimum operating altitude of the terrain database referenced guidance system was reduced from 300 ft to 150 ft with the addition of the Kalman filter state estimator.

Author (Herner)

A95-60168* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.

DESIGN OF A MODEL FOLLOWING, STATE VARIABLE FEEDBACK CONTROLLER FOR THE X-14 VTOL AIRCRAFT

L. HASDORFF Virginia Polytechnic Inst. and State Univ., Blacksburg, VA, US, L. D. CORLISS Army Air Mobility Research

and Development, Moffett Field, CA, US, and T. D. GOSSETT Army Air Mobility Research and Development, Moffett Field, CA, US In Asilomar Conference on Circuits and Systems, 4th, Pacific Grove, CA, Nov. 18-20, 1970 Santa Clara, CA Univ. of Santa Clara 1970 p. 597-601

(HTN-94-00685) Copyright

A model-following, state variable feedback controller is designed for the roll axis of the X-14. The approach is to define a criterion on roll axis performance and to find the gradient of this criterion in the space of parameters (the feedback gains) of the controller. The gradient is then used in a conjugate gradient descent sequence to numerically optimize the parameters.
Author (Hemer)

A95-60170* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.

SIMULATION DEVELOPMENT OF A FORWARD SENSOR-ENHANCED LOW-ALTITUDE GUIDANCE SYSTEM

RICHARD E. ZELENKA NASA. Ames Research Center, Moffett Field, CA, U.S.A., HARRY N. SWENSON NASA. Ames Research Center, Moffett Field, CA, U.S.A., MUNRO G. DEARING NASA. Ames Research Center, Moffett Field, CA, U.S.A., and GORDON H. HARDY NASA. Ames Research Center, Moffett Field, CA, U.S.A. 25 Oct. 1993 9p. IEEE/AIAA Digital Avionics Systems Conference, 12th, Ft. Worth, TX, Oct. 25-28, 1993, Paper (HTN-94-00688) Copyright

The requirement to operate aircraft at low-altitude near the terrain is common in the military community and essential for helicopters. The risk and crew workload in this flight regime is severe, with navigation, guidance, and obstacle avoidance demanding high attention. A guidance system relying on digitized terrain elevation maps has been developed that employs airborne navigation, mission requirements, aircraft performance limits, and radar altimeter returns to generate a valley-seeking, low-altitude trajectory between waypoints for display to the pilot. This system has been flight demonstrated to 150 ft above ground level altitude, and is primarily limited by the ability of the pilot to perform obstacle detection and avoidance. In this study, a wide field of view forward sensor has been modeled and incorporated in the guidance system for the purpose of relieving the pilot of the obstacle avoidance duty. The results of a piloted, motion-based simulation of this enhanced low-altitude guidance system is presented. Simulated flights to 50 ft altitude in the presence of obstacles were demonstrated while maintaining situational awareness and close tracking of the guidance trajectory.
Author (Hemer)

N95-10220* National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.

EXTENDED COOPERATIVE CONTROL SYNTHESIS

JOHN B. DAVIDSON and DAVID K. SCHMIDT Aug. 1994 22 p (Contract RTOP 505-64-52-01)
(NASA-TM-4561; L-17212; NAS 1.15:4561) Avail: CASI HC A03/MF A01

This paper reports on research for extending the Cooperative Control Synthesis methodology to include a more accurate modeling of the pilot's controller dynamics. Cooperative Control Synthesis (CCS) is a methodology that addresses the problem of how to design control laws for piloted, high-order, multivariate systems and/or non-conventional dynamic configurations in the absence of flying qualities specifications. This is accomplished by emphasizing the parallel structure inherent in any pilot-controlled, augmented vehicle. The original CCS methodology is extended to include the Modified Optimal Control Model (MOCM), which is based upon the optimal control model of the human operator developed by Kleinman, Baron, and Levison in 1970. This model provides a modeling of the pilot's compensation dynamics that is more accurate than the simplified pilot dynamic representation currently in the CCS methodology. Inclusion of the MOCM into the CCS also enables the modeling of pilot-observation perception thresholds and pilot-observation attention allocation affects. This Extended Cooperative Control Synthesis (ECCS) allows for the direct calculation of pilot and system open- and closed-loop transfer functions in pole/zero

form and is readily implemented in current software capable of analysis and design for dynamic systems. Example results based upon synthesizing an augmentation control law for an acceleration command system in a compensatory tracking task using the ECCS are compared with a similar synthesis performed by using the original CCS methodology. The ECCS is shown to provide augmentation control laws that yield more favorable, predicted closed-loop flying qualities and tracking performance than those synthesized using the original CCS methodology.
Author

N95-10717* National Aeronautics and Space Administration. Hugh L. Dryden Flight Research Center, Edwards, CA.

RADIO CONTROLLED FOR RESEARCH (Videotape)

Jul. 1994 Videotape: 3 min. 43 sec. playing time, in color, with sound (NASA-TM-104292; NONP-NASA-VT-94-23637) Avail: CASI VHS A01/BETA A22

This video presents how Dryden engineers use radio-controlled aircraft such as the 1/8-scale model F-18 High Alpha Research Vehicle (HARV) featured to conduct flight research.
DFRC

N95-10748* National Aeronautics and Space Administration. Hugh L. Dryden Flight Research Center, Edwards, CA.

F-15 PROPULSION CONTROLLED AIRCRAFT (PCA)

(Videotape) National Aeronautics and Space Administration. Hugh L. Dryden Flight Research Center, Edwards, CA. 1 Jul. 1993 Videotape: 2 min. playing time, in color, with sound (NASA-TM-104303; NONP-NASA-VT-94-23648) Avail: CASI VHS A01/BETA A22

This video presentation is a news release highlighting the F-15 Highly Integrated Digital Electronic Controls (HIDEC) Propulsion Controlled Aircraft (PCA) software through June 1993 at Dryden. DFRC

N95-10860* National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.

HIGH-ALPHA RESEARCH VEHICLE (HARV) LONGITUDINAL CONTROLLER: DESIGN, ANALYSES, AND SIMULATION RESULTS

AAPRON J. OSTROFF, KEITH D. HOFFER, MELISSA S. PROFFITT, PHILIP W. BROWN, MICHAEL R. PHILLIPS, ROBERT A. RIVERS, MICHAEL D. MESSINA, SUSAN W. CARZOO, BARTON J. BACON, and JOHN F. FOSTER Jul. 1994 64 p (Contract RTOP 505-68-30-05)
(NASA-TP-3446; L-17323; NAS 1.60:3446) Avail: CASI HC A04/MF A01

This paper describes the design, analysis, and nonlinear simulation results (batch and piloted) for a longitudinal controller which is scheduled to be flight-tested on the High-Alpha Research Vehicle (HARV). The HARV is an F-18 airplane modified for and equipped with the multi-axis thrust vectoring. The paper includes a description of the facilities, a detailed review of the feedback controller design, linear analysis results of the feedback controller, a description of the feed-forward controller design, nonlinear batch simulation results, and piloted simulation results. Batch simulation results include maximum pitch stick agility responses, angle of attack alpha captures, and alpha regulation for full lateral stick rolls at several alpha's. Piloted simulation results include task descriptions for several types of maneuvers, task guidelines, the corresponding Cooper-Harper ratings from three test pilots, and some pilot comments. The ratings show that desirable criteria are achieved for almost all of the piloted simulation tasks.
Author

N95-11223* Seagull Technology, Inc., Sunnyvale, CA.

ACSNT INNER LOOP FLIGHT CONTROL DESIGN STUDY

RICHARD BORTINS and JOHN A. SORENSEN Jul. 1993 191 p (Contract NAS2-13701)
(NASA-CR-196316; REPT-93122-01; NAS 1.26:196316) Avail: CASI HC A09/MF A02

The NASA Ames Research Center developed the Aircraft Synthesis (ACSNT) computer program to synthesize conceptual future aircraft designs and to evaluate critical performance metrics early in the

design process before significant resources are committed and cost decisions made. ACSYNT uses steady-state performance metrics, such as aircraft range, payload, and fuel consumption, and static performance metrics, such as the control authority required for the takeoff rotation and for landing with an engine out, to evaluate conceptual aircraft designs. It can also optimize designs with respect to selected criteria and constraints. Many modern aircraft have stability provided by the flight control system rather than by the airframe. This may allow the aircraft designer to increase combat agility, or decrease trim drag, for increased range and payload. This strategy requires concurrent design of the airframe and the flight control system, making trade-offs of performance and dynamics during the earliest stages of design. ACSYNT presently lacks means to implement flight control system designs but research is being done to add methods for predicting rotational degrees of freedom and control effector performance. A software module to compute and analyze the dynamics of the aircraft and to compute feedback gains and analyze closed loop dynamics is required. The data gained from these analyses can then be fed back to the aircraft design process so that the effects of the flight control system and the airframe on aircraft performance can be included as design metrics. This report presents results of a feasibility study and the initial design work to add an inner loop flight control system (ILFCS) design capability to the stability and control module in ACSYNT. The overall objective is to provide a capability for concurrent design of the aircraft and its flight control system, and enable concept designers to improve performance by exploiting the interrelationships between aircraft and flight control system design parameters.

Derived from text

N95-11487* Pratt and Whitney Aircraft, West Palm Beach, FL.
STOVL CONTROL INTEGRATION PROGRAM Final Report
 C. WEISS, P. MCDOWELL, and S. WATTS Cleveland, OH NASA
 Jul. 1994 202 p
 (Contracts NAS3-25194; RTOP 505-68-32)
 (NASA-CR-195358; E-9023; NAS 1.26:195358) Avail: CASI HC A10/
 MF A03

An integrated flight/propulsion control for an advanced vector thrust supersonic STOVL aircraft, was developed by Pratt & Whitney and McDonnell Douglas Aerospace East. The IFPC design was based upon the partitioning of the global requirements into flight control and propulsion control requirements. To validate the design, aircraft and engine models were also developed for use on a NASA Ames piloted simulator. Different flight control implementations, evaluated for their handling qualities, are documented in the report along with the propulsion control, engine model, and aircraft model.

Author

N95-11510* Carnegie-Mellon Univ., Pittsburgh, PA. Robotics Institute.
RESEARCH ON AN AUTONOMOUS VISION-GUIDED HELICOPTER
 OMEAD AMIDI, YUJI MESAKI, and TAKEO KANADE In NASA, Johnson Space Center, Conference on Intelligent Robotics in Field, Factory, Service and Space (CIRFFSS 1994), Volume 2 p 456-462 Mar. 1994

(AIAA PAPER 94-1240-CP) Copyright Avail: Issuing Activity
 Integration of computer vision with on-board sensors to autonomously fly helicopters was researched. The key components developed were custom designed vision processing hardware and an indoor testbed. The custom designed hardware provided flexible integration of on-board sensors with real-time image processing resulting in a significant improvement in vision-based state estimation. The indoor testbed provided convenient calibrated experimentation in constructing real autonomous systems.

CASI

RESEARCH AND SUPPORT FACILITIES (AIR)

Includes airports, hangars and runways; aircraft repair and overhaul facilities; wind tunnels; shock tube facilities; and engine test blocks.

A95-60155* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
VALIDATION OF THE DYNAMIC RESPONSE OF A BLADE-ELEMENT UH-60 SIMULATION MODEL IN HOVERING FLIGHT
 MARK G. BALLIN NASA. Ames Research Center, Moffett Field, CA, US and MAIRE-ALIX DALANG-SECRETAN Sterling Federal Systems, Inc., Palo Alto, CA, US Journal of the American Helicopter Society October 1991 p. 77-88 (HTN-94-00663) Copyright

The dynamic fidelity of an operational blade-element simulation model of the UH-60A helicopter is assessed for the hovering and low-speed flight regimes. Nonparametric frequency-response identification techniques and time-history comparisons are used to determine the validity of vehicle responses. Frequency-domain methods are applied to the model to isolate deficiencies and verify refinements and corrections. A dedicated flight-test program was conducted to provide data used in the analyses. Model deficiencies are also identified by using side-by-side pilot assessments of a motion-based simulation and of a test aircraft. Model refinements are found to improve fidelity significantly in the frequency range of interest to handling-qualities research. The applicability of the model to high-bandwidth flight-control research is also discussed.

Author (Herner)

A95-60156* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
EVALUATION OF SIMULATION MOTION FIDELITY CRITERIA IN THE VERTICAL AND DIRECTIONAL AXES
 JEFFERY A. SCHROEDER NASA. Ames Research Center, Moffett Field, CA, US 19 May 1993 19 p. American Helicopter Society Annual Forum, 49th, St. Louis, MO, May 19-21, 1993, Paper (HTN-94-00666) Copyright

An evaluation of existing motion fidelity criteria was conducted on the NASA Ames Vertical Motion Simulator. Experienced test pilots flew single-axis repositioning tasks in both the vertical and the directional axes. Using a first-order approximation of a hovering helicopter, tasks were flown with variations only in the filters that attenuate the commands to the simulator motion system. These filters had second-order high-pass characteristics, and the variations were made in the filter gain and natural frequency. The variations spanned motion response characteristics from nearly full math-model motion to fixed-base. Between configurations, pilots recalibrated their motion response perception by flying the task with full motion. Pilots subjectively rated the motion fidelity of subsequent configurations relative to this full motion case, which was considered the standard for comparison. The results suggested that the existing vertical-axis criterion was accurate for combinations of gain and natural frequency changes. However, if only the gain or the natural frequency was changed, the rated motion fidelity was better than the criterion predicted. In the vertical axis, the objective and-subjective results indicated that a larger gain reduction was tolerated than the existing criterion allowed. The limited data collected in the yaw axis revealed that pilots had difficulty in distinguishing among the variations in the pure yaw motion cues.

Author (Herner)

A95-60161* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
OPTIMUM FULL-SCALE SUBSONIC WIND TUNNEL
 K. W. MORT NASA. Ames Research Center, Moffett Field, CA, US, P. T. SODERMAN NASA. Ames Research Center, Moffett Field, CA, US, and LARRY A. MEYN NASA. Ames Research Center,

Moffett Field, CA, US Mar. 1986 19 p. AIAA Aero. Testing Conference, 14th, West Palm Beach, FL, March 1986 (AIAA PAPER 86-0732; HTN-94-00674) Copyright

The needs and reasons for performing full-scale subsonic research have been studied. Full-scale wind-tunnel requirements are described: recommended size, airspeed, acoustic capabilities, and flow quality are developed; and data-acquisition systems, productivity, automation, and some cost elements are discussed. It is proposed that the optimum full-scale, subsonic wind tunnel be large enough to accommodate aerodynamic and acoustic investigations on most advanced aircraft, which exhibit complex engine/lifting-surface flow-field interactions, including advanced rotorcraft. Author (Herner)

A95-60163* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.

AEROACOUSTIC PROBE DESIGN FOR MICROPHONE TO REDUCE FLOW-INDUCED SELF-NOISE

CRISTOPHER S. ALLEW Sterling Federal Systems, Moffett Field, CA, US and PAUL T. SODERMAN NASA. Ames Research Center, Moffett Field, CA, US 25 Oct. 1993 10 p. AIAA Aeroacoustics Conference, 15th, Long Beach, CA, Oct. 25-27, 1993 (AIAA PAPER 93-4343; HTN-94-00677) Copyright

A new aerodynamic microphone forebody design was tested in the National Full-scale Aerodynamics Complex (NFAC) at NASA Ames Research Center. An overview of the design theory is presented. The new microphone forebody was tested along with the industry standard Bruel and Kjaer (B&K) aerodynamic microphone forebody in the Ames 7- by 10-Foot Wind Tunnel, NFAC 40- by 80-Foot Wind Tunnel and Anechoic Chamber. The wind tunnel results show that high frequency tones, present with the B&K microphone forebody, are eliminated with the new probe. Broad band background noise levels at lower frequencies are also shown to decrease with the 1/4 inch version of the new probe. Finally, the Anechoic Chamber results show no difference in the directional characteristics between the new and B&K microphone forebodies below 80 kHz. Author (Herner)

A95-60165* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.

OBLIQUE INCIDENCE SOUND ABSORPTION OF POROUS MATERIALS COVERED BY PERFORATED METAL AND EXPOSED TO TANGENTIAL AIRFLOW

PAUL T. SODERMAN NASA. Ames Research Center, Moffett Field, CA, US May 1982 4 p. Inter-Noise 1982, San Francisco, CA, May 1982, Paper (HTN-94-00681) Copyright

The purpose of this study was to evaluate several acoustic linings that are candidate designs for the Ames 40- by 80-Foot Wind Tunnel test section. The acoustic treatment will be used to reduce wall reflections from aircraft model noise sources. The goal is not simply to attenuate sound propagating down the duct, but rather to create a semi-anechoic space in a windy environment by absorbing at least 80% of the incident acoustic energy over a wide frequency range, if possible. Author (Herner)

N95-10282 Johns Hopkins Univ., Laurel, MD. Applied Physics Lab. APPLICATION OF SCRAMJET ENGINE TECHNOLOGY TO THE DESIGN OF RAM ACCELERATOR PROJECTILES

DAVID M. VANWIE In its 30th JANNAF Combustion Subcommittee Meeting, Volume 1 p 123-144 Nov. 1993 Avail: CPIA, 10630 Little Patuxent Pkwy., Suite 202, Columbia, MD 21044-3200 HC

The ram accelerator is a relatively new concept for accelerating projectiles to very high speeds. By injecting a properly shaped projectile into a tube filled with a high-pressure combustible mixture, the projectile can be made to accelerate throughout the length of the tube. Many similarities exist in the flowfield generated by a ram accelerator projectile and that encountered in hypersonic airbreathing engines such as the dual-mode scramjet. A review of the principles

of design for hypersonic airbreathing engines is presented relative to their applicability to the design of ram accelerator projectiles. Specific design features discussed include the inlet compression process, shock-boundary layer interaction constraints, inlet over-contraction constraints, inlet performance correlations, isolator requirements and modelling, heat release zone requirements, and exhaust nozzle performance modelling. Theoretical analyses that were developed for the design and analysis of scramjet engines are applied to the prediction of ram accelerator performance. A suggestion for a new projectile design is provided. Author

N95-10284 Wright Lab., Eglin AFB, FL. EGLIN AIR FORCE BASE RAM ACCELERATOR RESEARCH FACILITY

R. P. DRABECZUK, D. M. LITTELL, G. E. ROLADER, and R. D. HUDSON In JHU, 30th JANNAF Combustion Subcommittee Meeting, Volume 1 p 159-170 Nov. 1993 Avail: CPIA, 10630 Little Patuxent Pkwy., Suite 202, Columbia, MD 21044-3200 HC

The U.S. Air Force, Wright Laboratory, Armament Directorate, located at Eglin Air Force Base (AFB), Florida and the U.S. Air Force Office of Scientific Research (AFOSR) are jointly supporting an in-house ram accelerator research program at Eglin AFB. As part of this program, a ram accelerator research facility has been designed and built on Eglin AFB. The facility consists of a conventional powder gun injector, a ten-foot long ven section, a twenty-foot long 93 mm diameter, ram acceleration section, a ten-foot long flight tube, a high-energy catch tank, a gas handling system, a 60 channel LeCroy and a 16 channel Nicolet data acquisition system, and two Programmable Logic Controllers. This paper describes the facility in detail and documents initial injector test results. Author

N95-10285 Army Research Lab., Aberdeen Proving Ground, MD. Weapons Technology Directorate.

PROCEEDING TOWARDS HYPERVELOCITIES IN RAM ACCELERATORS

DAVID L. KRUCZYNSKI In JHU, 30th JANNAF Combustion Subcommittee Meeting, Volume 1 p 171-180 Nov. 1993 Avail: CPIA, 10630 Little Patuxent Pkwy., Suite 202, Columbia, MD 21044-3200 HC

As research in ram acceleration has expanded worldwide, the ability to scale ram acceleration technology has been firmly established. Currently, three facilities of 38, 90, and 120-mm caliber are operational, while 3 others are under construction or undergoing preliminary tests. The next major advance in this technology will be achieving hypervelocities (greater than 3 km/s). This goal will require a careful multi-disciplinary approach involving computational fluid dynamics, experimentation, and optimization. This paper highlights recent experiments in 120-mm caliber including unique 'high' pressure and flow visualization experiments. Techniques designed to improve and extend ram accelerator performance in the future are discussed. Author

N95-10349# Loral Systems, Inc., Orlando, FL. Advanced Distributed Simulation Technology Program Office.

ADVANCED DISTRIBUTED SIMULATION TECHNOLOGY ADVANCED ROTARY WING AIRCRAFT. STRAWMAN

VERIFICATION AND VALIDATION PLAN FOR THE ARWA SIMULATOR SYSTEM

ROGER BRANSON and HOWARD FRY 15 Apr. 1994 154 p (Contract N61339-91-D-0001)

(AD-A280237; ADST/FR94-003282) Avail: CASI HC A08/MF A02

The ADST ARWA Strawman Verification and Validation Plan was developed during Phase 1 of the ADST ARWA program and is a 'living' document that will be revised to record effects of code changes and plans for validating correct implementation of modifications. The V&V plan has as its objective to provide a roadmap identifying both V&V process and information sources that will be required over the development cycle. The V&V plan outlines the

09 RESEARCH AND SUPPORT FACILITIES (AIR)

specifics of the approach that will be taken to determine if components fulfill design requirements and that system elements are in compliance with functional requirements. DTIC

N95-10350 Loral Systems, Inc., Orlando, FL. Adst Program Office. **ADVANCED DISTRIBUTED SIMULATION TECHNOLOGY ADVANCED ROTARY WING AIRCRAFT. SYSTEM/SEGMENT SPECIFICATION. VOLUME 1: SIMULATION SYSTEM MODULE** ROGER BRANSON and ROBERT ANSCHUETZ 31 Mar. 1994 64 p Limited Reproducibility: More than 20% of this document may be affected by microfiche quality (Contract N61339-91-D-0001) (AD-A280238; ADST/TR94-003276-VOL-1) Avail: CASI HC A04

The ADST ARWA System/Segment Specification establishes the functional requirements for the Advanced Rotary Wing Aircraft (ARWA) Simulator System (SS). Volume 1 describes the requirements for the Simulator System Module (SSM). The SSM component provides aircraft simulation for flight dynamics, flight controls, propulsion, navigation/communication, sensors, aircraft survivability equipment, weapons, and associated simulator support systems including physical cues, environment, and simulator control. DTIC

N95-10351# Loral Systems, Inc., Orlando, FL. Advanced Distributed Simulation Technology Program Office.

ADVANCED DISTRIBUTED SIMULATION TECHNOLOGY ADVANCED ROTARY WING AIRCRAFT. SYSTEM/SEGMENT SPECIFICATION. VOLUME 3: VISUAL SYSTEM MODULE ROGER BRANSON and ROBERT R. ANSCHUETZ, II 31 Mar. 1994 35 p (Contract N61339-91-D-0001) (AD-A280239; ADST/TR94-003276-VOL-3) Avail: CASI HC A03/MF A01

The ADST ARWA System/Segment Specification establishes the functional requirements for the Advanced Rotary Wing Aircraft (ARWA) Simulator System (SS). Volume 3 describes the requirements for the Visual System Module (VSM). The VSM component provides functions of global bus communication interfaces to the other segments, visual system controller, display device control, head tracker function control, and data base storage control. DTIC

N95-10352 Loral Systems, Inc., Orlando, FL. Adst Program Office. **ADVANCED DISTRIBUTED SIMULATION TECHNOLOGY ADVANCED ROTARY WING AIRCRAFT. SYSTEM/SEGMENT SPECIFICATION. VOLUME 2: FLIGHT STATION MODULE** ROGER BRANSON and ROBERT ANSCHUETZ 31 Mar. 1994 22 p Limited Reproducibility: More than 20% of this document may be affected by microfiche quality (Contract N61339-91-D-0001) (AD-A280432; ADST/TR-94-003276-VOL-2) Avail: CASI HC A03

The ADST ARWA System/Segment specification establishes the functional requirements for the Advanced Rotary Wing Aircraft (ARWA) Simulator System (SS). Volume 2 describes the requirements for the Flight Station Module (FSM). The FSM component provides aircraft simulation for electrical system, fuel management system, hydraulic system, and crew station interfaces associated with the flight station and its functions and control. DTIC

N95-10353 Loral Systems, Inc., Orlando, FL. Adst Program Office. **ADVANCED DISTRIBUTED SIMULATION TECHNOLOGY ADVANCED ROTARY WING AIRCRAFT. SYSTEM/SEGMENT SPECIFICATION. VOLUME 5: SIMULATION SYSTEM MODULE AH-64D KIT**

ROGER BRANSON and ROBERT ANSCHUETZ 31 Mar. 1994 23 p Limited Reproducibility: More than 20% of this document may be affected by microfiche quality (Contract N61339-91-D-0001) (AD-A280433; ADST/TR-94-003276-VOL-5) Avail: CASI HC A03

The ADST ARWA System/Segment Specification establishes the functional requirements for the Advanced Rotary Wing Aircraft (ARWA) Simulator System (SS). Volume 5 describes the requirements for the Simulator System Module (SSM) with respect to the aircraft specific models for the AH-64D Longbow Apache aircraft. The AH-64D Kit component provides aircraft simulation for flight dynamics, flight controls, propulsion, navigation/communication, sensors, aircraft survivability equipment, and weapons. DTIC

N95-10354 Loral Systems, Inc., Orlando, FL. Adst Program Office. **ADVANCED DISTRIBUTED SIMULATION TECHNOLOGY ADVANCED ROTARY WING AIRCRAFT. SOFTWARE REUSABILITY REPORT**

ROGER BRANSON, ROBERT ANSCHUETZ, KAREN BOURGEOIS, and PAUL KELLY 8 Apr. 1994 55 p Limited Reproducibility: More than 20% of this document may be affected by microfiche quality (Contract N61339-91-D-0001) (AD-A280434; ADST/TR-94-003281) Avail: CASI HC A04

The ADST ARWA Software Reusability Report provides a prediction of the effects on reusability of the software for the ARWA test bed and the ARWA Simulation System devices. The following three questions are addressed: (1) How reusable is the software when using the current development process?; (2) What is the predicted effect on reusability of implementing the IDACECOM/GA Tech recommendations?; and (3) What is the predicted effect on reusability of incorporating Ada style guidelines? Results of searches of source code and documentation libraries are included. DTIC

N95-10446# National Aeronautics and Space Administration. Lewis Research Center. Cleveland, OH.

NASA LEWIS PROPULSION SYSTEMS LABORATORY TEST ARTICLE SYSTEMS CRITERIA

RONALD H. SOEDER Jul. 1994 18 p (Contract RTOP 505-82-84) (NASA-TM-106589; E-8856; NAS 1.15:106589) Avail: CASI HC A03/MF A01

This report describes criteria for the design, analysis, and documentation of test article systems submitted for testing in the Propulsion Systems Laboratory at NASA Lewis Research Center. The functions of the facility manager, project engineer, operations engineer, research engineer, design engineer, and facility electrical engineer are defined. Customer-furnished test article systems and in-house test article systems are discussed. The format for test planning meetings, pre-run safety meetings, and test article criteria review are outlined. A discussion of the allowable stresses on a test article system is presented, and the format for a test article systems report is described. This report is required for each test article system tested in the Propulsion Systems Laboratory. The engineers responsible for developing this document are noted, as is the timetable for the delivery of this report to the project Author

N95-10547# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA. **LANGLEY OVERVIEW (Videotape)**

10 Feb. 1993 Videotape: 6 min. 31 sec. playing time (NASA-TM-109891; NONP-NASA-VT-94-23139) Avail: CASI VHS A01/BETA A22

This video presents a brief history of the Langley Research Center. LaRC

N95-10552# National Aeronautics and Space Administration, Washington, DC.

THE MODEL BUILDERS (Videotape)

Dec. 1991 Videotape: 2 min. 52 sec. playing time, with sound (NASA-TM-109802; NONP-NASA-VT-94-23144) Avail: CASI VHS A01/BETA A22

This video explores the world of modeling at the NASA Johnson Space Center. Artisans create models, large and small, to help sci-

tists and engineers make final design modifications before building more costly prototypes.

N95-10710* National Aeronautics and Space Administration. Hugh L. Dryden Flight Research Center, Edwards, CA.

DRYDEN OVERVIEW FOR SCHOOLS (Videotape)

28 Feb. 1992 Videotape: 6 min. 22 sec. playing time, in color, with sound
(NASA-TM-104282; NONP-NASA-VT-94-23630) Avail: CASI VHS A01/BETA A22

This video provides educators an overview of Dryden for students from late elementary through high school.

N95-10714* National Aeronautics and Space Administration. Hugh L. Dryden Flight Research Center, Edwards, CA.

DRYDEN TOUR TAPE, 1994 (Videotape)

Feb. 1994 Videotape: 19 min. 3 sec. playing time, in color, with sound
(NASA-TM-104288; NONP-NASA-VT-94-23634) Avail: CASI VHS A01/BETA A22

This video provides an overview of NASA's Dryden Flight Research Center. This is the program shown to visitors during the tour at Dryden.

N95-10738* National Aeronautics and Space Administration. Hugh L. Dryden Flight Research Center, Edwards, CA.

BUILDING THE INTEGRATED TEST FACILITY: A FOUNDATION FOR THE FUTURE (Videotape)

1 Oct. 1992 Videotape: 14 min. 7 sec. playing time, in color, with sound
(NASA-TM-104280; NONP-NASA-VT-94-23628) Avail: CASI VHS A01/BETA A22

A look at the construction and resources of Dryden's Integrated Test Facility is given.

N95-10746* National Aeronautics and Space Administration. Hugh L. Dryden Flight Research Center, Edwards, CA.

THE WESTERN AERONAUTICAL TEST RANGE (Videotape)

1 Aug. 1988 Videotape: 32 min. 15 sec. playing time, in color, with sound
(NASA-TM-104301; NONP-NASA-VT-94-23646) Avail: CASI VHS A01/BETA A22

An overview of the Western Aeronautical Test Range (WATR) and its connection to NASA Dryden is presented.

N95-10747* National Aeronautics and Space Administration. Hugh L. Dryden Flight Research Center, Edwards, CA.

DRYDEN OVERVIEW FOR SCHOOLS (Videotape)

3 Feb. 1994 Videotape: 6 min. 15 sec. playing time, in color, with sound
(NASA-TM-104302; NONP-NASA-VT-94-23647) Avail: CASI VHS A01/BETA A22

This video presentation gives a narrated, quick look at the Dryden Flight Research Center and the Center's various projects. The presentation is directed toward a 6th-grade audience and emphasizes staying in school to learn the vital skills needed to succeed today.

N95-10822* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.

NASA LEWIS PROPULSION SYSTEMS LABORATORY CUSTOMER GUIDE MANUAL

RONALD H. SOEDER Aug. 1994 51 p
(Contract RTOP 505-62-84)
(NASA-TM-106569; E-8769; NAS 1.15:106569) Avail: CASI HC A04/MF A01

This manual describes the Propulsion Systems Laboratory (PSL) at NASA Lewis Research Center. The PSL complex supports two large engine test cells (PSL-3 and PSL-4) that are capable of providing flight simulation to altitudes of 70,000 ft. Facility variables at the engine or test-article inlet, such as pressure, temperature, and Mach number (up to 3.0 for PSL-3 and up to 6.0 planned for PSL-4), are discussed.

Support systems such as the heated and cooled combustion air systems; the altitude exhaust system; the hydraulic system; the nitrogen, oxygen, and hydrogen systems; hydrogen burners; rotating screen assemblies; the engine exhaust gas-sampling system; the infrared imaging system; and single- and multiple-axis thrust stands are addressed. Facility safety procedures are also stated.

Author (revised)

N95-10844 Ecole Nationale Supérieure de l'Aéronautique et de l'Espace, Toulouse (France).

NUMERICAL STUDY OF GORTLER INSTABILITY:

APPLICATION TO THE DESIGN OF A QUIET SUPERSONIC

WIND TUNNEL Ph.D. Thesis [ETUDE NUMERIQUE DE

L'INSTABILITE DE GOERTLER: APPLICATION A LA

DEFINITION D'UNE SOUFFLERIE SUPERSONIQUE

SILENCIEUSE]

Y. HENNEQUIN 29 Sep. 1993 143 p In FRENCH See also PB94-147832 Sponsored by Direction des Recherches, Etudes et Techniques and Centre de Documentation de l'Armement (PB94-184801) Avail: Issuing Activity (National Technical Information Service (NTIS))

This paper presents several ways to approach Gortler vortices and the transition they are liable to cause. Experimental observations are used as a basis for qualitatively describing the physical aspects of instability. The author and his team devised numerical methods to model the vortices and predict any amplification. An existing computational code, based on using a local method to implement the linear laminar instability theory, was used to put together a database built around three flow parameters: local Mach number, wall temperature, and longitudinal pressure gradient. The team then used the database to analytically model the curve that plots changes in the local amplification rate as a function of Gortler number. This 'simplified' method sharply reduces computing time while providing precise information on the transition abscissa. The author and his team also modeled Gortler instability, again using linear laminar instability theory, but employing equations parabolized in the direction of the flow.

NTIS

N95-10919 Air Force Human Resources Lab., Brooks AFB, TX.

INSTRUCTIONAL CONTROL AND PART-WHOLE-TASK

TRAINING: A REVIEW OF THE LITERATURE AND AN

EXPERIMENTAL COMPARISON OF STRATEGIES APPLIED

TO INSTRUCTIONAL SIMULATION Final Report, May 1993 -

Feb. 1994

JOSEPH S. MATTOON May 1994 48 p Limited Reproducibility: More than 20% of this document may be affected by microfiche quality (AD-A280860; AL/HR-TR-1994-0041) Avail: Issuing Activity (Defense Technical Information Center (DTIC))

This experiment examined the effects of learner and program control and part-task and whole-task training strategies in a microcomputer-based instructional simulation program. Undergraduate Reserve Officer Training Corps (ROTC) students were taught how to use a simulated head-up display (HUD) and radar-electric optical (REO) display to estimate the location and heading of aircraft symbols on a computer screen. The part-task version of the program delivered instruction and practice on each of four parts of the target-estimation task. The whole-task version taught the entire task in one lesson. Subjects under learner control had the option to complete additional instruction after each practice activity, while those under program control received additional instruction when their practice performance was below criteria. Under program control, part-task subjects estimated targets significantly faster and spent significantly less time on instruction than whole-task subjects. Results also revealed a significant control by training task interaction that identified complex relationships among the instructional treatments.

DTIC

N95-11466* National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.

EFFECTS OF VIBRATION ON INERTIAL WIND-TUNNEL MODEL

ATTITUDE MEASUREMENT DEVICES

CLARENCE P. YOUNG, JR. (North Carolina State Univ., Raleigh, NC.), RALPH D. BUEHRLE, S. BALAKRISHNA, and W. ALLEN

10 ASTRONAUTICS

KILGORE Jul. 1994 34 p
(Contract RTOP 505-59-54-01)

(NASA-TM-109083; NAS 1.15:109083) Avail: CASI HC A03/MF A01

Results of an experimental study of a wind tunnel model inertial angle-of-attack sensor response to a simulated dynamic environment are presented. The inertial device cannot distinguish between the gravity vector and the centrifugal accelerations associated with wind tunnel model vibration, this situation results in a model attitude measurement bias error. Significant bias error in model attitude measurement was found for the model system tested. The model attitude bias error was found to be vibration mode and amplitude dependent. A first order correction model was developed and used for estimating attitude measurement bias error due to dynamic motion. A method for correcting the output of the model attitude inertial sensor in the presence of model dynamics during on-line wind tunnel operation is proposed.

Author

10

ASTRONAUTICS

Includes astronautics (general); astrodynamics; ground support systems and facilities (space); launch vehicles and space vehicles; space transportation; spacecraft communications, command and tracking; spacecraft design, testing and performance; spacecraft instrumentation; and spacecraft propulsion and power.

N95-10085 Mitsubishi Heavy Industries Ltd., Tokyo (Japan).

ACTIVITIES OF MITSUBISHI HEAVY INDUSTRIES LTD.

1993 89 p In JAPANESE See also PB94-149796

(PB94-179694) Copyright Avail: Issuing Activity (National Technical Information Service (NTIS))

Partial include: Development of HOPE and Experimental Vehicles; Development of Space Life Science Experiments and Development of Equipment for Them; 777 Next-Generation Large Commercial Transport Airplane; Application of Computational Fluid Dynamics to Development of Aerospace Products; Space Station JEM Engineering System Utilizing Artificial Gili; Fracture Mechanics Analysis on Multiple Cracked Stiffened Panel in Aircraft Structures; Study on Weaving Method/Strength Analysis for Three-Dimensional Textile Structural Composites; Study on Structural Integrity of High-Temperature, High-Pressure Parts in LE-7 Main Injector by Means of a Structural Model Test; Development of 3600 rpm 40 inch Titanium Blade and Actual Operating Results; Development of Process for Supercritical Propane Solvent Extraction of Ethanol from Water; and New Spatterless Welding Process Using Wire Feed Control System.

NTIS

N95-10553* National Aeronautics and Space Administration, Washington, DC.

AERO-SPACE PLANE: FLEXIBLE ACCESS TO SPACE

(Videotape)

Aug. 1991 Videotape: 3 min. 10 sec. playing time, in color, with sound (NASA-TM-109904; NONP-NASA-VT-94-23146) Avail: CASI VHS A01/BETA A22

The most recently designed X-30 (National Aerospace Plane) is described. The video feature also chronicles the development of the X-plane series, beginning with the X-1.

CASI

N95-10931# Joint Publications Research Service, Arlington, VA.

JPRS REPORT: SCIENCE AND TECHNOLOGY. CENTRAL EURASIA: ENGINEERING AND EQUIPMENT. GAS DYNAMICS OF SUPERSONIC SHORTENED NOZZLES

N. D. KOVALENKO, G. A. STRELNIKOV, YU. V. GORA, L. Z. GREBENYUK, and V. V. PILIPENKO 24 Jan. 1994 17 p Transl. into ENGLISH of Gazodinamika Sverkhzvukovykh Ukorochnykh Sopol (Kiev, Russia), 19 Nov. 1992 p 1-6, 216-224

(JPRS-UST-94-003-L) Avail: CASI HC A03/MF A01

The outcome of theoretical and experimental research into controlled nozzle blocks with a short length and high degree of expansion which are promising for application aircraft engines with an elevated configuration density are presented. Special attention is focused on plate-type annular nozzles and nozzles with cylindrical and bell-shaped nozzle heads. The issues of shaping the control surfaces as well as the methods of analyzing localized and integral parameters, particularly pressure profiles and rate characteristics and impulse responses, are considered.

CASI

N95-11003*# National Aeronautics and Space Administration, Langley Research Center, Hampton, VA.

DESIGN AND EVALUATION OF CANDIDATE PRESSURE

PORTS FOR THE HYFLITE EXPERIMENT

JOHN E. TETER, JR., CRAIG S. CLECKNER, and ALFRED E. VONTHEUMER Jul. 1994 69 p

(Contract RTOP 763-01-51-25)

(NASA-TM-109146; NAS 1.15:109146) Avail: CASI HC A04/MF A01

A concept for placing a pressure transducer directly in a shuttle type tile was developed at Langley Research Center. A 5 inch long quartz with a .020 inch inner diameter provides the thermal isolation necessary to allow 2800 F surface pressure measurements to be taken by pressure transducer rated at 250 F. The assembly is potted in place with RTV 560 in a piece of FRCl-12 thermal protection system insulation tile. The integrity of the thermal protection system is maintained even with the intrusion of the pressure port assembly and the pressure port does not disrupt the air flow across the lifting body. Approximately 200 of these pressure ports are to be used in each of the Hypersonic Flight Experiment (HYFLITE) flight tests. Initial vibroacoustic and aerothermal testing of the pressure port designs have been completed at Langley Research vibration laboratory and the 20 MWatt 2 x 9 turbulent duct facility at Ames Research Center. The performance of the pressure ports were found to be well within the required design limits for all cases. In addition, a failure mode in which the entire pressure port assembly was removed proved to be a begin case.

Author

N95-11483*# National Aeronautics and Space Administration, Lewis Research Center, Cleveland, OH.

BRUSH SEAL PERFORMANCE AND DURABILITY ISSUES

BASED ON T-700 ENGINE TEST RESULTS

R. C. HENDRICKS Mar. 1994 19 p

(Contract RTOP 232-01-04)

(NASA-TM-106502; E-8520; NAS 1.15:106502) Avail: CASI HC A03/MF A01

The integrity and performance of brush seals have been established. Severe bench and engine tests have shown high initial wear or run-in rates, material smearing at the interface, and bristle and rubber wear, but the brush seals did not fail. Short-duration (46 hr) experimental T-700 engine testing of the compressor discharge seal established over 1-percent engine performance gain (brush versus labyrinth). Long-term gains were established only as leakage comparisons, with the brush at least 20 percent better at controlling leakage. Long-term materials issues, such as wear and ultimately seal life, remain to be resolved. Future needs are cited for materials and analysis tools that account for heat generation, thermomechanical behavior, and tribological pairing to enable original equipment manufacturers to design high-temperature, high-surface-speed seals with confidence.

Author

N95-10231*# Texas Univ., San Antonio, TX. Engineering Div.

MICRO-MEASUREMENTS OF MECHANICAL PROPERTIES

FOR ADHESIVES AND COMPOSITES USING DIGITAL

IMAGING TECHNOLOGY Final Report

HAL F. BRINSON 27 Jun. 1994 18 p Presented at the 10th International Conference on Experimental Mechanics, Lisboa, Portugal, 18-22 Jul. 1994 Submitted for publication

(Contracts NCC2-724; N00014-82-K-0185; CR-4303-430220; T2-341085/8BO3)
(NASA-CR-196111; NAS 1.26:196111; UTSA-MM2-6274) Avail: CASI HC A03/MF A01

The need for a constituent based durability or accelerated life prediction procedure to be used for the engineering design of polymer matrix composites is discussed in the light of current plans for the High Speed Civil Transport (HSCT) concerns about the U.S. infrastructure (bridges, pipelines, etc.) and other technological considerations of national concern. It is pointed out that good measurement procedures for *in situ* resin properties are needed for both adhesives and composites. A double cantilever beam (DCB) specimen which shows promise for the easy determination of adhesive shear properties is presented and compared with measurements of strains within the bondline using a new optical digital imaging micro-measurement system (DIMMS). The DCB specimen is also used to assess damage in a bonded joint using a dynamic mechanical thermal analysis system (DMTA). The possible utilization of the same DIMMS and DMTA procedures to determine the *in situ* properties of the resin in a composite specimen are discussed as well as the use of the procedures to evaluate long term mechanical and physical aging. Finally, a discussion on the state-of-the-art of the measurement of strains in micron and sub-micron domains is given.

Author (revised)

N95-10296 Pennsylvania State Univ., University Park, PA. Dept. of Mechanical Engineering.
FLAME-SPREADING PHENOMENA IN THE FIN-SLOT REGION OF A SOLID ROCKET MOTOR
KENNETH K. KUO, R. A. KOKAL, M. PAULAUSKAS, P. ALAKSIN, and LEE S. LEE. In JHU, 30th JANNAF Combustion Subcommittee Meeting, Volume 1 p 375-386 Nov. 1993
Avail: CPIA, 10630 Little Patuxent Pkwy., Suite 202, Columbia, MD 21044-3200 HC

Flame-spreading processes in the fin-slot regions of solid-propellant motor grains have the potential to influence the behavior of the overall ignition transient. The work being done on this project is aimed at obtaining a better understanding of the flame-spreading processes in rocket motors with aft-end fin slots. Nonintrusive optical diagnostic methods were employed to acquire flame-spreading measurements in the fin-slot region of a subscale rocket motor. Highly non-uniform flame-spreading processes were observed in both the deep and shallow fin regions of the test rig. The average flame-spreading rates in the fin-slot region were found to be two orders of magnitude less than those in the circular port region of a typical rocket motor. The flame-spreading interval was found to correlate well with the local pressurization rates. A higher pressurization rate produces a shorter flame-spreading time interval.

Author

N95-10318# Dow Chemical Co., Midland, MI.
NOVEL MATRIX RESINS FOR COMPOSITES FOR AIRCRAFT PRIMARY STRUCTURES, PHASE 1 Final Report, Apr. 1989 - Mar. 1992

EDMUND P. WOO, P. M. PUCKETT, S. MAYNARD, M. T. BISHOP, K. J. BRUZA, J. P. GODSCHALX, and M. J. MULLINS Aug. 1992 164 p

(Contracts NAS1-18841; RTOP 510-02-11-02)

(NASA-CR-189657; NAS 1.26:189657) Avail: CASI HC A08/MF A02

The objective of the contract is the development of matrix resins with improved processability and properties for composites for primarily aircraft structures. To this end, several resins/systems were identified for subsonic and supersonic applications. For subsonic aircraft, a series of epoxy resins suitable for RTM and powder prepreg was shown to give composites with about 40 ksi compressive strength after impact (CAI) and 200 Fwet mechanical performance. For supersonic applications, a thermoplastic toughened cyanate prepreg system has demonstrated excellent resistance to heat aging at 360 F for 4000 hours, 40 ksi CAI and useful mechanical properties at greater than or equal to 310 F. An AB-BCB-maleimide resin was identified as a leading candidate for the HSCT. Composite panels fabricated by RTM show CAI of approxi-

mately 50 ksi, 350 Fwet performance and excellent retention of mechanical properties after aging at 400 F for 4000 hours. Author

N95-10535# California Univ., San Diego, La Jolla, CA.
THEORIES OF TURBULENT COMBUSTION IN HIGH SPEED FLOWS Annual Report, Apr. 1993 - Apr. 1994
P. A. LIBBY and F. A. WILLIAMS 25 May 1994 6 p
(Contract F49620-92-J-0184)

This research involves theoretical studies of the chemical and fluid-mechanical phenomena which make turbulent combustion in high-speed flows different from such combustion in low-speed flows. Finite-rate chemistry plays a significant role in high-speed flows because of the small ratios of flow times to chemical times. The studies address ignition and extinction phenomena in nonpremixed turbulent combustion of hydrogen-air systems by both numerical and asymptotic methods. Attention also is paid to effects of compressibility in high-speed turbulent combustion, with consideration given to interdispersed configurations of shocklets and flamelets. Efforts are made to provide a firmer foundation for the modeling of high-speed turbulent reacting flows, to aid in the development of a formulation which gives results that can be compared with experiments on turbulent combustion.

Author (DTIC)

N95-10132# Colorado Univ., Boulder, CO. Coll. of Engineering
HIGH PERFORMANCE PARALLEL ANALYSIS OF COUPLED PROBLEMS FOR AIRCRAFT PROPULSION Final Report
C. A. FELIPPA, C. FARHAT, S. LANTERI, N. MAMAN, S. PIPERNO, and U. GUMASTE Cleveland, OH NASA Jul. 1994 108 p
(Contracts NAG3-1425; RTOP-509-10-11; NAS ASC-92-17394) (NASA-CR-195355; E-9007; NAS 1.26:195355) Avail: CASI HC A06/MF A02

In order to predict the dynamic response of a flexible structure in a fluid flow, the equations of motion of the structure and the fluid must be solved simultaneously. In this paper, we present several partitioned procedures for time-integrating this focus coupled problem and discuss their merits in terms of accuracy, stability, heterogeneous computing, I/O transfers, subcycling, and parallel processing. All theoretical results are derived for a one-dimensional piston model problem with a compressible flow, because the complete three-dimensional aeroelastic problem is difficult to analyze mathematically. However, the insight gained from the analysis of the coupled piston problem and the conclusions drawn from its numerical investigation are confirmed with the numerical simulation of the two-dimensional transient aeroelastic response of a flexible panel in a transonic nonlinear Euler flow regime.

Author

N95-10244# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.

FLUTTER ANALYSIS OF SUPERSONIC AXIAL FLOW CASCADES USING A HIGH RESOLUTION EULER SOLVER. PART 1: FORMULATION AND VALIDATION

T. S. R. REDDY (Toledo Univ., OH.), MILIND A. BAKHLE (Toledo Univ., OH.), DENNIS L. HUFF, and TIMOTHY W. SWAFFORD Aug. 1992 56 p

(Contract RTOP 535-03-10)

(NASA-TM-105798; E-7229; NAS 1.15:105798) Avail: CASI HC A04/MF A01

This report presents, in two parts, a dynamic aeroelastic stability (flutter) analysis of a cascade of blades in supersonic axial flow. Each blade of the cascade is modeled as a typical section having pitching and plunging degrees of freedom. Aerodynamic forces are obtained from a time accurate, unsteady, two-dimensional cascade solver based on the Euler equations. The solver uses a time marching flux-difference splitting (FDS) scheme. Flutter stability is analyzed in the frequency domain. The unsteady force coefficients required in the analysis are obtained by harmonically oscillating (HO) the blades for a given flow condition, oscillation frequency, and interblade phase angle. The calculated time history of the forces is then Fourier decomposed to give

10 ASTRONAUTICS

the required unsteady force coefficients. An influence coefficient (IC) method and a pulse response (PR) method are also implemented to reduce the computational time for the calculation of the unsteady force coefficients for any phase angle and oscillation frequency. Part 1, this report, presents these analysis methods and their validation by comparison with results obtained from linear theory for a selected flat plate cascade geometry. A typical calculation for a rotor airfoil is also included to show the applicability of the present solver for airfoil configurations. The predicted unsteady aerodynamic forces for a selected flat plate cascade geometry and flow conditions correlated well with those obtained from linear theory for different interblade phase angles and oscillation frequencies. All the three methods of predicting unsteady force coefficients, namely, HO, IC, and PR, showed good correlations with each other. It was established that only a single calculation with four blade passages is required to calculate the aerodynamic forces for any phase angle for a cascade consisting of any number of blades, for any value of the oscillation frequency. Flutter results, including mistuning effects, for a cascade of stator airfoils are presented in Part 2 of the report.

Author

N95-10854*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.

CONTROL OF WIND TUNNEL OPERATIONS USING NEURAL NET INTERPRETATION OF FLOW VISUALIZATION RECORDS
ALVIN E. BUGGELE and ARTHUR J. DECKER Aug. 1994 22 p
Presented at the Ohio Area Net Workshop, Columbus, OH, 16 Aug. 1994; sponsored by the Ohio Aerospace Institute
(Contract RTOP 307-50-00)
(NASA-TM-106683; E-9034; NAS 1.15:106683) Avail: CASI HC A03/MF A01

Neural net control of operations in a small subsonic/transonic/supersonic wind tunnel at Lewis Research Center is discussed. The tunnel and the layout for neural net control or control by other parallel processing techniques are described. The tunnel is an affordable, multiuser platform for testing instrumentation and components, as well as parallel processing and control strategies. Neural nets have already been tested on archival schlieren and holographic visualizations from this tunnel as well as recent supersonic and transonic shadowgraph. This paper discusses the performance of neural nets for interpreting shadowgraph images in connection with a recent exercise for tuning the tunnel in a subsonic/transonic cascade mode of operation. That mode was operated for performing wake surveys in connection with NASA's Advanced Subsonic Technology (AST) noise reduction program. The shadowgraph was presented to the neural nets as 60 by 60 pixel arrays. The outputs were tunnel parameters such as valve settings or tunnel state identifiers for selected tunnel operating points, conditions, or states. The neural nets were very sensitive, perhaps too sensitive, to shadowgraph pattern detail. However, the nets exhibited good immunity to variations in brightness, to noise, and to changes in contrast. The nets are fast enough so that ten or more can be combined per control operation to interpret flow visualization data, point sensor data, and model calculations. The pattern sensitivity of the nets will be utilized and tested to control wind tunnel operations at Mach 2.0 based on shock wave patterns.

Author

N95-11135# Ames Lab., IA.
LOW FREQUENCY ULTRASONIC NONDESTRUCTIVE INSPECTION OF ALUMINUM/ADHESIVE FUSELAGE LAP SPLICES Ph.D. Thesis
T. PATTON Jan. 1994 112 p
(Contract W-7405-ENG-82)
(DE94-014242; IS-T-1681) Avail: CASI HC A06/MF A02

This thesis is a collection of research efforts in ultrasonics, conducted at the Center for Aviation Systems Reliability located at Iowa State University, as part of the Federal Aviation Administration's 'Aging Aircraft Program'. The research was directed toward the development of an ultrasonic prototype to inspect the aluminum/adhesive fuselage lap splices found on 1970's vintage Boeing passenger aircraft. The

ultrasonic prototype consists of a normal incidence, low frequency inspection technique, and a scanning adapter that allows focused immersion transducers to be operated in a direct contact manner in any inspection orientation, including upside-down. The inspection technique uses a computer-controlled data acquisition system to produce a C-scan image of a radio frequency (RF) waveform created by a low frequency, broadband, focused beam transducer, driven with a spike voltage pulser. C-scans produced by this technique are color representations of the received signal's peak-to-peak amplitude (voltage) taken over an (x, y) grid. Low frequency, in this context, refers to a wavelength that is greater than the lap splice's layer thicknesses. With the low frequency technique, interface echoes of the lap splice are not resolved and gating of the signal is unnecessary; this in itself makes the technique simple to implement and saves considerable time in data acquisition. Along with the advantages in data acquisition, the low frequency technique is relatively insensitive to minor surface curvature and to ultrasonic interference effects caused by adhesive bondline thickness variations in the lap splice.

DOE

N95-11168# Wichita State Univ., KS. National Inst. for Aviation Research.

PLASTIC HINGE MODELING OF STRUCTURES M.S. Thesis
RAMAKRISHNAN MARUTHAYAPPAN 1994 119 p
(NIAR-94-14) Avail: CASI HC A06/MF A02

The rapid changes taking place in vehicle design has resulted in a great variety of vehicles having different structural configurations. The behavior of such structures under impact or crash conditions demand an efficient modeling of the system. Since a vehicle crash is a dynamic phenomenon exhibiting complex interaction between structural and inertial forces, the model should be able to predict the transient deformations which range from small strain elastic deformations to large strain plastic deformations. Among various formulations and modeling techniques available, the plastic hinge theory offers a simple, realistic and a computationally efficient model. This thesis explores and applies the plastic hinge modeling technique to some simple structures ranging from an elementary cantilever beam to a torque box representing a passenger compartment. The nonlinear static and dynamic behavior of a general aviation seat model for different load cases have been predicted using this theory. A detailed study and application of nonlinear finite element technique has also been performed. A comparative study of the responses yielded by plastic hinge model and finite element model demonstrates the effectiveness and accuracy of the plastic hinge model in predicting the behavior of the structures reliably. This thesis also studies and predicts the dynamics of mechanical systems using plastic hinges modeled with flexible and rigid bodies with contact-impact and plastic deformation.

Author

N95-11252*# Ohio State Univ., Columbus. ElectroScience Lab.
A USERS MANUAL FOR THE METHOD OF MOMENTS AIRCRAFT MODELING CODE (AMC), VERSION 2
M. E. PETERS and E. H. NEWMAN Jul. 1994 194 p
(Contract NAG1-1058)
(NASA-CR-196445; NAS 1.26:196445; ESL-TR-722792-6) Avail: CASI HC A09/MF A03

This report serves as a user's manual for Version 2 of the 'Aircraft Modeling Code' or AMC. AMC is a user-oriented computer code, based on the method of moments (MM), for the analysis of the radiation and/or scattering from geometries consisting of a main body or fuselage shape with attached wings and fins. The shape of the main body is described by defining its cross section at several stations along its length. Wings, fins, rotor blades, and radiating monopoles can then be attached to the main body. Although AMC was specifically designed for aircraft or helicopter shapes, it can also be applied to missiles, ships, submarines, jet inlets, automobiles, spacecraft, etc. The problem geometry and run control parameters are specified via a two character command language input format. This report describes the input command language and also includes several examples which illustrate typical code inputs and outputs.

Author

N95-11280# Hood Technology Corp., Hood River, OR.
ADAPTIVE TUNED VIBRATION ABSORBERS: TUNING LAWS, TRACKING AGILITY, SIZING, AND PHYSICAL IMPLEMENTATIONS

ANDREAS H. VONFLOTOW, ANDREW BEARD, and DON BAILEY
In Inst. of Noise Control Engineering, Noise Con 1994; Proceedings of the 1994 National Conference on Noise Control Engineering. Progress in Noise Control for Industry p 437-454 1994 Sponsored by ONR
 Avail: Issuing Activity (Inst. of Noise Control Engineering, Noise Control Foundation, P.O. Box 2469 Arlington Branch, Poughkeepsie, NY 12603)

This paper surveys the tuned vibration absorber (and its variant, the tuned mass damper). The introduction offers a broad survey of physical implementations of passive absorbers. We then summarize steady-state tuning criteria and steady-state performance and emphasize the need for accurate tuning. We introduce the self-tuning absorber and quantify the limits of applicability for rapidly time-varying disturbances. We then offer a brief survey of existing self-tuning absorber implementations and tuning laws. Author

N95-11288# Florida Atlantic Univ., Boca Raton, FL. Center for Applied Stochastics Research.

EXACT DYNAMIC RESPONSES OF PERIODIC MULTI-SPAN BEAMS UNDER CONVECTED PRESSURE FIELDS

LI-PING ZHU *In* Inst. of Noise Control Engineering, Noise Con 1994: Proceedings of the 1994 National Conference on Noise Control Engineering, Progress in Noise Control for Industry p 513-518 1994 (Contract NCC10-5)
 Avail: Issuing Activity (Inst. of Noise Control Engineering, Noise Control Foundation, P.O. Box 2469 Arlington Branch, Poughkeepsie, NY 12603)

Response of a structure to a convected pressure field generated by far-field jet-noise or turbulent boundary layer is often of interest in engineering. The structure considered in present study is a periodic beam with equally rotational elastic supports. The convected pressure field is characterized by a broad frequency spectrum and a particular convection velocity. In the first order approximation, all the frequency components in the pressure spectrum are convected with the same velocity. In this paper, both finitely and infinitely long periodic beams under convected harmonic pressure are investigated. The exact harmonic responses are obtained by introducing new expressions of mode shapes for these two types of beams into the normal mode approach. Thus, both locations and values of the response peaks in the propagation bands can be precisely predicted and the important coincidence phenomenon can be investigated in exact terms. This work provides a foundation on which the study on vibration control of structure can be conducted. Author

N95-11330 Naval Postgraduate School, Monterey, CA.
DEVELOPMENT OF AN EXPERIMENTAL FACILITY FOR ANALYSIS OF ROTORDYNAMIC PHENOMENA M.S. Thesis
 FRANK A. SIMEI, JR. Mar. 1994 70 p Limited Reproducibility: More than 20% of this document may be affected by microfiche quality (AD-A281897) Avail: CASI HC A04

An experimental facility was developed to investigate the rotordynamic phenomena of rotating machinery during subcritical, resonant and supercritical operation. The behavior of the rotor was characterized throughout the operating range. The facility consists of a Bentley Nevada Corporation Rotor Kit integrated with a computerized data acquisition and control process. A LabVIEW Virtual Instrument was designed to collect, analyze and display rotor position and rotor displacement information. Experiments conducted included construction of Cascade plots, analytic prediction of the first lateral mode and demonstration of synchronous whirl due to a mass imbalance, during which, backward whirl was experienced. DTIC

N95-11389# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.

DYNAMIC RESPONSE OF NASA ROTOR TEST APPARATUS AND SIKORSKY S-76 HUB MOUNTED IN THE 80- BY 120- FOOT WIND TUNNEL

RANDALL L. PETERSON and MUHAMMED S. HOQUE Sep. 1994 36 p
 (Contract RTOP 505-59-36)
 (NASA-TM-108847; A-94133; NAS 1.15:108847) Avail: CASI HC A03/MF A01

A shake test was conducted in the 80- by 120-Foot Wind Tunnel at NASA Ames Research Center, using the NASA Ames Rotor Test Apparatus (RTA) and the Sikorsky S-76 rotor hub. The primary objective of this shake test was to determine the modal properties of the RTA, the S-76 rotor hub, and the model support system installed in the wind tunnel. Random excitation was applied at the rotor hub, and vibration responses were measured using accelerometers mounted at various critical locations on the model and the model support system. Transfer functions were computed using the load cell data and the accelerometer responses. The transfer function data were used to compute the system modal parameters with the aid of modal analysis software. Author

N95-11409# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
RADIANT ENERGY MEASUREMENTS FROM A SCALED JET ENGINE AXISYMMETRIC EXHAUST NOZZLE FOR A BASELINE CODE VALIDATION CASE

JOSEPH F. BAUMEISTER Aug. 1994 19 p
 (Contract RTOP 505-62-70)
 (NASA-TM-106686; E-9042; NAS 1.15:106686) Avail: CASI HC A03/MF A01

A non-flowing, electrically heated test rig was developed to verify computer codes that calculate radiant energy propagation from nozzle geometries that represent aircraft propulsion nozzle systems. Since there are a variety of analysis tools used to evaluate thermal radiation propagation from partially enclosed nozzle surfaces, an experimental benchmark test case was developed for code comparison. This paper briefly describes the nozzle test rig and the developed analytical nozzle geometry used to compare the experimental and predicted thermal radiation results. A major objective of this effort was to make available the experimental results and the analytical model in a format to facilitate conversion to existing computer code formats. For code validation purposes this nozzle geometry represents one validation case for one set of analysis conditions. Since each computer code has advantages and disadvantages based on scope, requirements, and desired accuracy, the usefulness of this single nozzle baseline validation case can be limited for some code comparisons. Author

13 GEOSCIENCES

Includes geosciences (general); earth resources; energy production and conversion; environment pollution; geophysics; meteorology and climatology; and oceanography.

A95-60227
VALIDATION OF EMPIRICAL ORBIT ERROR CORRECTIONS USING CROSSOVER DIFFERENCE DIFFERENCES

G. W. JOLLY Aston Univ., Birmingham, England and P. MOORE Aston Univ., Birmingham, England *Journal of Geophysical Research* (ISSN 0148-0227) vol. 99, no. C3 March 15, 1994 p. 5237-5248 (HTN-94-00912) Copyright

Numerous techniques for empirical correction of the dominant once per revolution orbit error present in satellite altimeter data have been suggested along with various tests of their validity. These validations typically involve comparison of data from other sources, for

13 GEOSCIENCES

example tide gauges, with altimetry, comparison of different orbit error models with which to approximate the radial error, or comparison of variabilities from collinear analyses with those from crossover differences. A new means of validating empirical orbit error correction is here presented through use of crossover difference differences (CDDs) to independently eliminate the dominant orbit error terms. A CDD, $C(\text{sub } i, j)$, is defined to be $C(\text{sub } i, j) = X(\text{sub } i+1, j+1) - X(\text{sub } i, j)$, where $X(\text{sub } i, j)$ is the crossover difference derived from the intersection of ascending arc number i with descending arc number j ; the arcs i and $i+1$, for example, are separated in time by one orbital period. This provides a measure of the change in ocean height difference between two geographical locations on the same circle of latitude, separated by an angle χ , equal to the angle through which the Earth has rotated during the orbital period. Removal of residual gravity field modeling error and systematic solar radiation pressure orbit errors produce a result that is purely ocean signal differences plus residual noise contamination. CDDs have been applied with Geosat crossover difference data from the Southern Ocean to validate an empirical correction technique obtained by combining the methods suggested by Milbert et al. (1988) and Tai (1988). The comparison has shown that a maximum, nonstochastic annual signal of less than 1.5 cm was absorbed by empirical correction. In addition, it has been shown that relative height time series can be generated χ due east or west of a known time series without any need for further orbit error reduction. Author (Hemer)

N95-10567* National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.

VERTICAL WIND ESTIMATION FROM HORIZONTAL WIND MEASUREMENTS

DAN D. VICROY In *its* Airborne Windshear Detection and Warning Systems. Fifth and Final Combined Manufacturers' and Technologists' Conference, Part 1 p 143-176 Jul. 1994
Avail: CASI HC A03/MF A04

The objective of this study was to assess the ability of simple vertical wind models to improve the hazard prediction capability of an airborne Doppler sensor in a realistic microburst environment. The results indicate that in the altitude region of interest (at or below 300 meters), both the linear and empirical vertical wind models improved the hazard estimate. The radar simulation study showed that the magnitude of the performance improvement was altitude dependent. The altitude of maximum performance improvement occurred at about 300 meters. At the lower altitudes the percent improvement was minimized by the diminished contribution of the vertical wind. The vertical hazard estimate errors from flight tests were less than those of the radar simulation study. Derived from text

N95-10568* National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.

CHARACTERISTICS OF A DRY, PULSATING MICROBURST AT DENVER STAPLETON AIRPORT

FRED H. PROCTOR In *its* Airborne Windshear Detection and Warning Systems. Fifth and Final Combined Manufacturers' and Technologists' Conference, Part 1 p 177-187 Jul. 1994
Avail: CASI HC A03/MF A04

This study examines the influence of ambient vertical wind shear on microburst intensity, asymmetry, and translation. Results show that microburst asymmetry is influenced by the magnitude of the low-level ambient vertical shear. The microburst outflow elongates in the direction of the shear vector (which is not necessarily in the direction of the shear vector), and generates the greatest hazard (for commercial jet transports) along paths orthogonal to the shear vector. The model results also show that the asymmetry increases with increasing shear magnitude. One implication of these results concerns the detection of a microburst by a ground-based doppler systems. These systems may underestimate the hazard for landing and departing aircraft that are on trajectories orthogonal to both the sensor beam and shear vector, especially if the magnitude of the shear is large. Another implication is that microburst are more likely to be asymmetrical in regions (seasons) where there is climatologically a significant low-level shear. The model

results also show that the rotor microbursts and severe wind damage can be a product of the microburst interaction with strong ambient wind shear. Derived from text

N95-10657* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.

THREE DIMENSIONAL MODEL CALCULATIONS OF THE GLOBAL DISPERSION OF HIGH SPEED AIRCRAFT EXHAUST AND IMPLICATIONS FOR STRATOSPHERIC OZONE LOSS

ANNER. DOUGLASS, RICHARD B. ROOD, CHARLES H. JACKMAN, and CLARK J. WEAVER In *its* Ozone in the Troposphere and Stratosphere, Part 1 p 281-284 Apr. 1994
Avail: CASI HC A01/MF A04

Two-dimensional (zonally averaged) photochemical models are commonly used for calculations of ozone changes due to various perturbations. These include calculating the ozone change expected as a result of change in the lower stratospheric composition due to the exhaust of a fleet of supersonic aircraft flying in the lower stratosphere. However, zonal asymmetries are anticipated to be important to this sort of calculation. The aircraft are expected to be restricted from flying over land at supersonic speed due to sonic booms, thus the pollutant source will not be zonally symmetric. There is loss of pollutant through stratosphere/troposphere exchange, but these processes are spatially and temporally inhomogeneous. Asymmetry in the pollutant distribution contributes to the uncertainty in the ozone changes calculated with two dimensional models. Pollutant distributions for integrations of at least 1 year of continuous pollutant emissions along flight corridors are calculated using a three dimensional chemistry and transport model. These distributions indicate the importance of asymmetry in the pollutant distributions to evaluation of the impact of stratospheric aircraft on ozone. The implications of such pollutant asymmetries to assessment calculations are discussed, considering both homogeneous and heterogeneous reactions. Author

15

MATHEMATICAL AND COMPUTER SCIENCES

Includes mathematical and computer sciences (general); computer operations and hardware; computer programming and software; computer systems; cybernetics; numerical analysis; statistics and probability; systems analysis; and theoretical mathematics.

N95-10859* National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.

COMPUTER-AIDED LIGHT SHEET FLOW VISUALIZATION USING PHOTOGRAMMETRY

KATHRYN STACY, KURT SEVERANCE, and BROOKS A. CHILDERS Jul. 1994 37 p Original contains color illustrations
(Contract RTOP 505-90-53-02)
(NASA-TP-3416; L-17291; NAS 1.60:3416) Avail: CASI HC A03/MF A01; 7 functional color pages

A computer-aided flow visualization process has been developed to analyze video images acquired from rotating and translating light sheet visualization systems. The computer process integrates a mathematical model for image reconstruction, advanced computer graphics concepts, and digital image processing to provide a quantitative and a visual analysis capability. The image reconstruction model, based on photogrammetry, uses knowledge of the camera and light sheet locations and orientations to project two-dimensional light sheet video images into three-dimensional space. A sophisticated computer visualization package, commonly used to analyze computational fluid dynamics (CFD) results, was chosen to interactively display the reconstructed light sheet images with the numerical surface geometry for the model or aircraft under study. The photogrammetric reconstruction technique and the image processing and computer graphics techniques and equipment are described. Results of the computer-

aided process applied to both a wind tunnel translating light sheet experiment and an in-flight rotating light sheet experiment are presented. The capability to compare reconstructed experimental light sheet images with CFD solutions in the same graphics environment is also demonstrated.
Author (revised)

N95-11513* Universitaet der Bundeswehr Muenchen, Neubiberg (Germany).
THE 4-D APPROACH TO VISUAL CONTROL OF AUTONOMOUS SYSTEMS

ERNST D. DICKMANN. In NASA. Johnson Space Center, Conference on Intelligent Robotics in Field, Factory, Service and Space (CIRFSS 1994), Volume 2 p 483-493 Mar. 1994 (AIAA PAPER 94-1243-CP) Copyright Avail: Issuing Activity

Development of a 4-D approach to dynamic machine vision is described. Core elements of this method are spatio-temporal models oriented towards objects and laws of perspective projection in a forward mode. Integration of multi-sensory measurement data was achieved through spatio-temporal models as invariants for object recognition. Situation assessment and long term predictions were allowed through maintenance of a symbolic 4-D image of processes involving objects. Behavioral capabilities were easily realized by state feedback and feed-forward control.
CASI

N95-11525* Jet Propulsion Lab., California Inst. of Tech., Pasadena, CA.
A GENERIC TELEROBOTICS ARCHITECTURE FOR C-5

PAUL G. BACKES, WAYNE ZIMMERMAN, and MICHAEL B. LEAHY, JR. In NASA. Johnson Space Center, Conference on Intelligent Robotics in Field, Factory, Service and Space (CIRFSS 1994), Volume 2 p 630-639 Mar. 1994 (AIAA PAPER 94-1264-CP) Copyright Avail: Issuing Activity

The feasibility of applying telerobotics to the maintenance of C-5A aircraft is discussed. A variety of maintenance applications are evaluated for the inclusion of telerobotics technology.
CASI

N95-11593* Institute for Computer Applications in Science and Engineering, Hampton, VA.
3D VISUALIZATION OF UNSTEADY 2D AIRPLANE WAKE VORTICES Final Report

KWAN-LIU MA and Z. C. ZHENG Jun. 1994 20 p Submitted for publication
(Contracts NAS1-19480; NAG1-1437; RTOP 505-90-52-01) (NASA-CR-194931; NAS 1.26:194931; ICASE-94-45) Avail: CASI HC A03/MF A01

Air flowing around the wing tips of an airplane forms horizontal tornado-like vortices that can be dangerous to following aircraft. The dynamics of such vortices, including ground and atmospheric effects, can be predicted by numerical simulation, allowing the safety and capacity of airports to be improved. In this paper, we introduce three-dimensional techniques for visualizing time-dependent, two-dimensional wake vortex computations, and the hazard strength of such vortices near the ground. We describe a vortex core tracing algorithm and a local tiling method to visualize the vortex evolution. The tiling method converts time-dependent, two-dimensional vortex cores into the induced rolling moment on the following airplane at each grid point within a region near the vortex tubes and thus allows three-dimensional visualization of the hazard strength of the vortices. We also suggest ways of combining multiple visualization methods to present more information simultaneously.
Author

Includes physics (general); acoustics; atomic and molecular physics; nuclear and high-energy physics; optics; plasma physics; solid-state physics; and thermodynamics and statistical physics.

A95-60166* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
ON THE SCALING OF SMALL-SCALE JET NOISE TO LARGE SCALE

PAUL T. SODERMAN NASA. Ames Research Center, Moffett Field, CA, U.S.A. and CHRISTOPHER S. ALLEN Sterling Federal Systems, Moffett Field, CA, U.S.A. May 1992 9 p. DGLR/AIAA Aerodynamics Conference, 14th, Aachen, Germany, May 1992 (AIAA PAPER 92-02109; HTN-94-00682) Copyright

An examination was made of several published jet noise studies for the purpose of evaluating scale effects important to the simulation of jet aerodynamics. Several studies confirmed that small conical jets, one as small as 59 mm diameter, could be used to correctly simulate the overall or perceived noise level (PNL) noise of large jets dominated by mixing noise. However, the detailed acoustic spectra of large jets are more difficult to simulate because of the lack of broad-band turbulence spectra in small jets. One study indicated that a jet Reynolds number of 5×10^6 (exp 6) based on exhaust diameter enabled the generation of broad-band noise representative of large jet mixing noise. Jet suppressor aerodynamics is even more difficult to simulate at small scale because of the small mixer nozzles with flows sensitive to Reynolds number. Likewise, one study showed incorrect ejector mixing and entrainment using a small-scale, short ejector that led to poor acoustic scaling. Conversely, fairly good results were found with a longer ejector and, in a different study, with a 32-chute suppressor nozzle. Finally, it was found that small-scale aerodynamic resonance produced by jets impacting ground boards does not reproduce at large scale.
Author (Hemer)

N95-11166 Southampton Univ. (England). Inst. of Sound and Vibration Research.
NEAR FIELD NOISE PREDICTION REQUIREMENTS

M. J. FISHER and K. R. HOLLAND Jun. 1994 57 p (ISVR-TR-234) Avail: Issuing Activity (Inst. of Sound and Vibration Research, Univ. of Southampton, Southampton SO9 5NH, England)

The work to be presented in this paper represents a portion of an on-going study in the UK to develop rational, as opposed to purely empirical methods, for the prediction of the near field pressures generated by high speed jet flows. In the case of the mixing noise component the method relies on the measurement or prediction of the far-field noise plus information of the distribution of source strength along the jet axis. The latter is obtained from previously published source location methods. We begin by defining the essential input parameters for the prediction of the near field pressures created by the broadband shock associated noise. Following the Harper-Bourne/Fisher model for shock associated noise these are shown to be essentially the individual amplitudes and mutual coherence of the shock cell sources. A technique for the determination of these quantities is then described. Specifically it is shown that a set of cross spectra, measured between microphones located in the geometric far field, may be processed, in conjunction with a parametric description of the source distribution, to retrieve the required information via a process of least squares fitting and matrix inversion. While this method clearly has much in common with the previously described polar correlation technique the requirements for data processing are shown to differ in a number of essential aspects in the presence of an array of correlated, as opposed to incoherent, sources. These requirements will be described theoretically and demonstrated in terms of a numerical simulation experiment. The latter also includes the effects of both statistical errors in the cross spectral data estimates and errors in the assumed source locations. It

16 PHYSICS

is shown, perhaps most importantly, that for coherent sources a number of reference microphones must be employed, as opposed to one for the case of an incoherent source array. The benefits of a least squares fit procedure in obtaining valid data, particularly at low frequencies where individual sources are poorly resolved, is also discussed and demonstrated.

Author (revised)

N95-11192* MCAT Inst., San Jose, CA.

HIGH SPEED CIVIL TRANSPORT: SONIC BOOM SOFTENING AND AERODYNAMIC OPTIMIZATION Progress Report

SAMSON CHEUNG Jul. 1994 40 p

(Contract NCC2-617)

(NASA-CR-196397; NAS 1.26:196397; MCAT-94-10) Avail: CASI HC A03/MF A01

An improvement in sonic boom extrapolation techniques has been the desire of aerospace designers for years. This is because the linear acoustic theory developed in the 60's is incapable of predicting the nonlinear phenomenon of shock wave propagation. On the other hand, CFD techniques are too computationally expensive to employ on sonic boom problems. Therefore, this research focused on the development of a fast and accurate sonic boom extrapolation method that solves the Euler equations for axisymmetric flow. This new technique has brought the sonic boom extrapolation techniques up to the standards of the 90's. Parallel computing is a fast growing subject in the field of computer science because of its promising speed. A new optimizer (IOWA) for the parallel computing environment has been developed and tested for aerodynamic drag minimization. This is a promising method for CFD optimization making use of the computational resources of workstations, which unlike supercomputers can spend most of their time idle. Finally, the OAW concept is attractive because of its overall theoretical performance. In order to fully understand the concept, a wind-tunnel model was built and is currently being tested at NASA Ames Research Center. The CFD calculations performed under this cooperative agreement helped to identify the problem of the flow separation, and also aided the design by optimizing the wing deflection for roll trim.

Derived from text

N95-11259 Institute of Noise Control Engineering, Poughkeepsie, NY. Noise Control Foundation. **NOISE CON 1994: PROCEEDINGS OF THE 1994 NATIONAL CONFERENCE ON NOISE CONTROL ENGINEERING. PROGRESS IN NOISE CONTROL FOR INDUSTRY**

JOSEPH M. CUSCHIERI, ed. (Florida Atlantic Univ., Boca Raton, FL.), **STEWART A. L. GLEGG**, ed. (Florida Atlantic Univ., Boca Raton, FL.), and **DAVID M. YEAGER**, ed. (Florida Atlantic Univ., Boca Raton, FL.) 1994 1088 p Conference held in Fort Lauderdale, FL, 1-4 May 1994 Sponsored in part by Florida Atlantic Univ. and IBM

(ISSN 0736-2935)

(LC-75-24750; ISBN-0-931784-27-1) Copyright Avail: Issuing Activity (Inst. of Noise Control Engineering, Noise Control Foundation, P.O. Box 2469 Arlington Branch, Poughkeepsie, NY 12603)

The theme of the conference was progress in noise control for industry. The proceedings is comprised of 165 technical papers, and the topics span all aspects of noise control pertaining to industry; that is, product and machinery noise control, industrial noise control, implementations of active noise control, transportation noise, and so on.

N95-11260* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.

FAN NOISE RESEARCH AT NASA

JOHN F. GROENEWEG In Inst. of Noise Control Engineering, Noise Con 1994: Proceedings of the 1994 National Conference on Noise Control Engineering. Progress in Noise Control for Industry p 43-52 1994 See also N94-25172

Avail: Issuing Activity (Inst. of Noise Control Engineering, Noise Control Foundation, P.O. Box 2469 Arlington Branch, Poughkeepsie, NY 12603)

Results of recent NASA research to reduce aircraft turbofan noise

are described. As the bypass ratio of a turbofan engine increases from 5 to as much as 20, the dominant source of engine noise is the fan. A primary mechanism of tone noise generation is the rotor blade wakes interacting with downstream stator vanes. Methods of analyzing rotor-stator tone noise generation are described and sample results are given. The role of an acoustic modal description is emphasized. Wind tunnel tests of model fans and nacelles are described including a novel rotating microphone technique for modal measurement. Sample far field results are given showing the effects of inlet length, and modal measurements are shown which point to a new generation mechanism. Concepts for active fan noise control at the source are addressed. Implications of the research which have general relevance to fan noise generation and control are discussed.

Author

N95-11261# Boeing Commercial Airplane Co., Seattle, WA.

TRANSMISSION LOSS CHARACTERISTICS OF AIRCRAFT SIDEWALL SYSTEMS TO CONTROL CABIN INTERIOR NOISE

OKTAY YESIL, **PAUL M. SERATI**, **ERIC V. HOFBECK**, and **BILLY M. GLOVER** In Inst. of Noise Control Engineering, Noise Con 1994: Proceedings of the 1994 National Conference on Noise Control Engineering. Progress in Noise Control for Industry p 93-98 1994

Avail: Issuing Activity (Inst. of Noise Control Engineering, Noise Control Foundation, P.O. Box 2469 Arlington Branch, Poughkeepsie, NY 12603)

We have explored the possibility of using new, light weight, and acoustically effective materials on aircraft interiors to control noise. The sidewall system elements were evaluated for increased TL in the laboratory. Measured TL for a given configuration, relative to a baseline, was used as an indication of the TL change to be expected for modifications. Test data were in good agreement with the predicted levels. The TL contributions due to all sidewall components were important for interior cabin noise control. Polyimide foam insulation was inferior to fiberglass in the mid-frequency range; however, foam was a better performer at high frequencies. Fiberglass/polyimide foam composite blankets, with less weight, provided noise reductions similar to fiberglass. 'Premium' fiberglass was slightly better performer than the standard fiberglass. Solid fiberglass interior trim panel provided adequate noise performance. Production-type trim attachment design could be improved to control flanking path for sound transmission.

Author

N95-11262# Pennsylvania State Univ., State College, PA. Applied Research Lab.

EMPIRICAL REFINEMENTS TO BOUNDARY LAYER TRANSITION NOISE MODELS

RICHARD C. MARBOE and **GERALD C. LAUCHLE** In Inst. of Noise Control Engineering, Noise Con 1994: Proceedings of the 1994 National Conference on Noise Control Engineering. Progress in Noise Control for Industry p 209-214 1994 Sponsored by ONR; ARL; and IBM

Avail: Issuing Activity (Inst. of Noise Control Engineering, Noise Control Foundation, P.O. Box 2469 Arlington Branch, Poughkeepsie, NY 12603)

We have discussed two similar theoretical models for direct radiation from a transitioning boundary layer zone. When Ffowcs Williams suggested that a turbulent spot may yield 'intense sound radiation', he suggested that analysis was insufficient to resolve the growth mechanism and that empiricism was necessary. The predicted radiated noise levels due to the transition process are sensitive to several factors which will require such empirical description in order to practically use the models, whether applied to flow over a wall, around a body of revolution, or over an airfoil or hydrofoil. They include: the effect of the dynamics of the spot substructures identified by Sankaran et al. on the normal surface velocity, $v_{(sub\ n)}$; accurate displacement thickness rise time, $t_{(sub\ t)}$ and spatially-dependent normal velocity measurements; and effects of adverse pressure gradient including the possibility of laminar separation prior to transition. The radiated noise component magnitude can be added to the convective and low

wavenumber contribution to find the wall pressure forcing spectrum as input to the fluid-structure interaction problems of interest. Author

N95-11263# Florida Atlantic Univ., Boca Raton, FL. Dept. of Ocean Engineering.
EFFECT OF WEAK PERIODIC PRESSURE GRADIENT ON

STREAMWISE VORTICES NEAR A WALL

MANHAR R. DHANAK and B. R. NERAVETLA In Inst. of Noise Control Engineering, Noise Con 1994: Proceedings of the 1994 National Conference on Noise Control Engineering, Progress in Noise Control for Industry p 215-218 1994

(Contract NSF BCS-92-11847)
 Avail: Issuing Activity (Inst. of Noise Control Engineering, Noise Control Foundation, P.O. Box 2469 Arlington Branch, Poughkeepsie, NY 12603)

Control of turbulence, which has a bearing on the control of associated surface pressure fluctuation characteristics, by induced harmonic pressure gradients in the flow has been a topic of recent interest. Thus, in an experimental investigation of pulsatile turbulent flow in a channel, Tardu and Binder observed strong modulation of the ejection and bursting frequencies during the cyclic period of the flow. Further, Junet et al., in a direct simulation of the turbulent flow in a channel, found that an induced oscillatory motion of a wall of the channel or the introduction of a weak oscillatory cross-flow resulted in significant attenuation of turbulence production. Such an attenuation, coupled with the effect of the oscillatory flow on the coherent vortices is likely to have a significant impact on the induced pressure field at the wall. Here we examine the motion of vortices in a cross-plane under an imposed straining flow. We consider a model incompressible flow in which the dynamics of the coherent eddies are assumed to be governed by inviscid equations of motion. While viscous effects play a significant role in the eventual dissipation of the eddies and in the bursting process at the wall, it is expected that, at leave over a limited time period, the motion and evolution of the coherent vortices under an imposed straining flow can be well described by inviscid dynamics of the flow. In particular, we examine the effect of a harmonic plane straining flow on the structure of a longitudinal vortex undergoing stretching in the streamwise direction. A quasi two-dimensional problem, involving evolving eddies, placed over a rigid wall in a three-dimensional, unsteady straining flow, is considered. The vorticity within the core of the eddy is taken to be uniform but a function of time; calculations involving motion of patches of distributed vorticity suggest that a uniform vorticity model gives a good approximate description of the evolution of the vortex. The evolution is followed here using the contour dynamics technique. Author

N95-11270# Pennsylvania State Univ., University Park, PA. Graduate Program in Acoustics.

ACHIEVEMENTS AND TASKS FOR ACTIVE NOISE CONTROL

JIRI TICHY In Inst. of Noise Control Engineering, Noise Con 1994: Proceedings of the 1994 National Conference on Noise Control Engineering, Progress in Noise Control for Industry p 309-314 1994
 Avail: Issuing Activity (Inst. of Noise Control Engineering, Noise Control Foundation, P.O. Box 2469 Arlington Branch, Poughkeepsie, NY 12603)

This short survey attempted to highlight some achievements of the latest active control applications. Except for the active control of a one-dimensional sound field in ducts and active headphones, the applications for active control technology are still being developed. Although the principles of active control are simple, their applications still require substantial research and modeling of the sound fields to find optimal solutions. There is no doubt that active control of sound field triggered extensive research of the fundamental properties of the sound field which goes beyond the textbook simplifications. Also, new hardware, particularly actuators, are under development. As more realism is brought into assessment of applicability of active control, we will see in the future increasing confidence of industry to adopt this new technology. Author

N95-11271# SRI International Corp., Menlo Park, CA. Applied Control and Signal Processing Group.

ACTIVE CONTROL OF COMPLEX NOISE PROBLEMS USING A BROADBAND, MULTICHANNEL CONTROLLER

D. KENT PETERSON, WILLIAM A. WEEKS, and WILLIAM C. NOWLIN In Inst. of Noise Control Engineering, Noise Con 1994: Proceedings of the 1994 National Conference on Noise Control Engineering, Progress in Noise Control for Industry p 315-320 1994

Avail: Issuing Activity (Inst. of Noise Control Engineering, Noise Control Foundation, P.O. Box 2469 Arlington Branch, Poughkeepsie, NY 12603)

Active noise control (ANC) systems for quieting simple noise fields are well-known and now commercially available for certain applications. These systems offer a solution under certain simplifying assumptions about the noise source (e.g., tonal spectrum) and/or environment (e.g., 1-dimensional or ducted geometry). However, many important noise problems don't meet these confining requirements, and require a more sophisticated active noise control solution. In this paper, we describe an approach for quieting spectrally and spatially complex noise fields using broadband, multichannel control techniques. The methodology is demonstrated on a machinery noise problem - a reciprocating-piston air compressor - using a special-purpose, multichannel controller developed at SRI for a wide variety of noise and vibration control applications. Real-time cancellation of approximately 15 dB is obtained over a broad bandwidth (50-1500 Hz) and large quiet volume. A primary concern for practical applications is the ability to deliver good cancellation under varying environmental conditions (e.g., shifts in sound speed or multipath) or even perturbations in system geometry (e.g., sensor/actuator placement). We discuss methods for maintaining satisfactory cancellation performance under time-varying conditions by means of both adaptive and robust control techniques. Author

N95-11275*# Purdue Univ., West Lafayette, IN. School of Mechanical Engineering.

ACTIVE CONTROL OF TURBOMACHINE DISCRETE TONES

SANFORD FLEETER In Inst. of Noise Control Engineering, Noise Con 1994: Proceedings of the 1994 National Conference on Noise Control Engineering, Progress in Noise Control for Industry p 379-388 1994

Sponsored by NASA, Lewis Research Center
 Avail: Issuing Activity (Inst. of Noise Control Engineering, Noise Control Foundation, P.O. Box 2469 Arlington Branch, Poughkeepsie, NY 12603)

This paper was directed at active control of discrete frequency noise generated by subsonic blade rows through cancellation of the blade row interaction generated propagating acoustic waves. First discrete frequency noise generated by a rotor and stator in a duct was analyzed to determine the propagating acoustic pressure waves. Then a mathematical model was developed to analyze and predict the active control of discrete frequency noise generated by subsonic blade rows through cancellation of the propagating acoustic waves, accomplished by utilizing oscillating airfoil surfaces to generate additional control propagating pressure waves. These control waves interact with the propagating acoustic waves, thereby, in principle, canceling the acoustic waves and thus, the far field discrete frequency tones. This model was then applied to a fan exit guide vane to investigate active airfoil surface techniques for control of the propagating acoustic waves, and thus the far field discrete frequency tones, generated by blade row interactions. Author

N95-11276# Virginia Polytechnic Inst. and State Univ., Blacksburg, VA. Vibration and Acoustics Labs.

ACTIVE CONTROL OF INTERIOR NOISE IN A BUSINESS JET USING PIEZOCERAMIC ACTUATORS

CHRIS R. FULLER and GARY P. GIBBS In Inst. of Noise Control Engineering, Noise Con 1994: Proceedings of the 1994 National Conference on Noise Control Engineering, Progress in Noise Control for Industry p 389-394 1994

Sponsored by Cessna Aircraft Co.
 Avail: Issuing Activity (Inst. of Noise Control Engineering, Noise Control

16 PHYSICS

Foundation, P.O. Box 2469 Arlington Branch, Poughkeepsie, NY 12603)

Preliminary experiments on controlling interior noise in a medium sized business jet using small patch type piezoceramic actuators bonded to the fuselage are reported. The results demonstrate that the piezoceramic patch actuators have enough control authority for this application. In addition, for the dominant noise case of a cabin resonance, reasonable sound reductions with only four control inputs were measured throughout the cabin space except at one location. Results at the off-resonance case show reduced control performance. Important nonlinear behavior, most likely due to curving the flat piezoceramic actuators on attachment was identified.

Author

N95-11277# Virginia Polytechnic Inst. and State Univ., Blacksburg, VA. Vibration and Acoustics Labs.

ANALYTICAL INVESTIGATION OF ADAPTIVE CONTROL OF RADIATED INLET NOISE FROM TURBOFAN ENGINES

JOHN D. RISI and RICARDO A. BURDISSO *In* Inst. of Noise Control Engineering, Noise Con 1994: Proceedings of the 1994 National Conference on Noise Control Engineering. Progress in Noise Control for Industry p 395-402 1994

(Contract NAG1-230)

Avail: Issuing Activity (Inst. of Noise Control Engineering, Noise Control Foundation, P.O. Box 2469 Arlington Branch, Poughkeepsie, NY 12603)

An analytical model has been developed to predict the resulting far field radiation from a turbofan engine inlet. A feedforward control algorithm was simulated to predict the controlled far field radiation from the destructive combination of fan noise and secondary control sources. Numerical results were developed for two system configurations, with the resulting controlled far field radiation patterns showing varying degrees of attenuation and spillover. With one axial station of twelve control sources and error sensors with equal relative angular positions, nearly global attenuation is achieved. Shifting the angular position of one error sensor resulted in an increase of spillover to the extreme sidelines. The complex control inputs for each configuration was investigated to identify the structure of the wave pattern created by the control sources, giving an indication of performance of the system configuration. It is deduced that the locations of the error sensors and the control source configuration are equally critical to the operation of the active noise control system.

Author

N95-11283# SRI International Corp., Menlo Park, CA. Applied Control and Signal Processing Group.

BROADBAND, WIDE-AREA ACTIVE CONTROL OF SOUND RADIATED FROM VIBRATING STRUCTURES USING LOCAL SURFACE-MOUNTED RADIATION SUPPRESSION DEVICES

V. BRADFORD MASON, KOOROSH NAGHSHINEH, and G. K. TOTH *In* Inst. of Noise Control Engineering, Noise Con 1994: Proceedings of the 1994 National Conference on Noise Control Engineering. Progress in Noise Control for Industry p 467-472 1994

Avail: Issuing Activity (Inst. of Noise Control Engineering, Noise Control Foundation, P.O. Box 2469 Arlington Branch, Poughkeepsie, NY 12603)

A new active noise-control device, which offers a practical solution for complex noise problems, has been developed and experimentally evaluated. Noise reduction is achieved by distributing an array of control devices over the surface of the radiating structure (e.g., aircraft fuselage interior). Each device consists of a motion sensor, a control circuit, and a loudspeaker. The control circuits are independent and can be manufactured inexpensively from analog components. The loudspeaker is driven such that it reduces the volume velocity of the radiating structure within its close proximity. Experimental verification of this concept was performed using a uniformly vibrating circular plate with a single device. The controller transfer function was derived and implemented in an analog circuit. Broadband (50-500 Hz) sound reductions in the range of 10-20 dB were achieved over a wide spatial area, including the immediate vicinity of the device. The controller was found to be stable and robust. Since this device in its final implementation may be mounted behind the aircraft trim panels, it was covered

by a large, flexible panel. The performance was measured and found to be excellent.

Author

N95-11287# Boeing Commercial Airplane Co., Seattle, WA. COMMENTS ON THE USE OF STRUCTUREBORNE NOISE ANALYSIS FOR LARGE COMMERCIAL AIRPLANES

STEVEN E. MARSHALL and LEO M. BUTZEL *In* Inst. of Noise Control Engineering, Noise Con 1994: Proceedings of the 1994 National Conference on Noise Control Engineering. Progress in Noise Control for Industry p 493-494 1994

Avail: Issuing Activity (Inst. of Noise Control Engineering, Noise Control Foundation, P.O. Box 2469 Arlington Branch, Poughkeepsie, NY 12603)

In a business climate of continuous cost reduction, noise control engineers are ever more dependent on computer simulation in lieu of testing. Several analytical methodologies have been applied to predicting structureborne transmission, fuselage response, and passenger cabin noise. In order to facilitate problem solution, simplifying assumptions are typically made related to the structural configurations or boundary conditions. Yet, results from the same prediction schemes demonstrate significant cabin noise sensitivity to the simplifications themselves. This paper is submitted in support of the objectives and activities of the Institute of Noise Control Engineers (INCE) Structureborne Noise Technical Subcommittee. The characteristic dynamic behavior of commercial transport fuselage structure as related to geometry-frequency scales and to engineering/customer issues are briefly described. Then, recommendations are extended with regard to concerns and interests associated with cabin noise within Boeing airplanes.

Author

N95-11304# Naval Sea Systems Command, Washington, DC.

A THEORETICAL ANALYSIS OF AIRBORNE SOUND TRANSFER FOR A RESILIENTLY MOUNTED MACHINE TO ITS FOUNDATION

MICHAEL F. SHAW and COURTNEY B. BURROUGHS *In* Inst. of Noise Control Engineering, Noise Con 1994: Proceedings of the 1994 National Conference on Noise Control Engineering. Progress in Noise Control for Industry p 615-620 1994

Avail: Issuing Activity (Inst. of Noise Control Engineering, Noise Control Foundation, P.O. Box 2469 Arlington Branch, Poughkeepsie, NY 12603)

Comparisons of predicted airborne transmission losses between parallel plates to predicted transmission losses for resilient mounts revealed that airborne transmission losses were often less than the losses through the mounts at frequencies above 100 Hz. This implies that the airborne transmission path may be significant in many well-designed single-stage resilient mounting systems, particularly at frequencies from 100 Hz to 1 kHz. Below 100 Hz, the transmission losses through the mounts are below the airborne transmission losses, except where resonances between the plate occur. Above 1 kHz, predictions of airborne transmission losses are above 55 dB, which implies that airborne transmission paths are not likely to be dominant at frequencies above 1 kHz in typical mounting systems.

Author

N95-11306# Boeing Commercial Airplane Co., Seattle, WA.

EFFECT OF CONSTRAINING LAYER STIFFNESS ON PERFORMANCE OF DAMPING TILE MATERIALS USING FINITE ELEMENT MODELLING WITH RAYLEIGH INTEGRAL

JEFFREY M. ORZECZOWSKI and ALAN E. LANDMANN *In* Inst. of Noise Control Engineering, Noise Con 1994: Proceedings of the 1994 National Conference on Noise Control Engineering. Progress in Noise Control for Industry p 627-632 1994

Avail: Issuing Activity (Inst. of Noise Control Engineering, Noise Control Foundation, P.O. Box 2469 Arlington Branch, Poughkeepsie, NY 12603)

Three different materials are proposed as options for high-leverage constrained-layer acoustical damping tiles when applied to an aircraft skin with stringers. The finite element method is used to calculate the complex velocity at an array of positions on the surface of the structure. Far-field radiated mean square pressure, between 350

and 1000 Hz, is then calculated from these complex velocities using the Rayleigh integral. This methodology is applied to evaluate damping tile performance as a function of material flexural modulus. Each configuration studied has identical geometry and viscoelastic material but varies in tile flexural modulus only. The results indicate that sound transmission reduction performance increases significantly with increasing damping tile flexural modulus. Author

N95-11307# Wyle Labs., Inc., Arlington, VA.
25 YEARS OF AIRPORT SOUND INSULATION PROGRAMS
 BEN H. SHARP In Inst. of Noise Control Engineering, Noise Control 1994; Proceedings of the 1994 National Conference on Noise Control Engineering, Progress in Noise Control for Industry p 641-648 1994
 Avail: Issuing Activity (Inst. of Noise Control Engineering, Noise Control Foundation, P.O. Box 2469 Arlington Branch, Poughkeepsie, NY 12603)

Airport sound insulation programs have come a long way in the U.S. since the early, tentative start in the late 1960s. At first considered not cost-effective, the combination of federal funding and the fact that there are no other obvious ways to reduce community noise, has resulted in these programs forming a major part of many airport's noise mitigation programs. Along the way, the acoustics community has developed some techniques for the prediction and measurement of aircraft noise reduction, but, unfortunately, there has been little standardization. The most significant outcome of airport sound insulation programs has been the satisfaction of thousands of families who can now carry on a more normal life in communities adjacent to airports. Author

N95-11310# BBN Systems and Technologies Corp., Canoga Park, CA.
ASSESSING EFFECTS OF MILITARY AIRCRAFT NOISE ON RESIDENTIAL PROPERTY VALUES NEAR AIRBASES
 SANFORD FIDELL, BARBARA TABACHNICK, LAURA SILVATI, and BRENDAN COOK In Inst. of Noise Control Engineering, Noise Control 1994; Proceedings of the 1994 National Conference on Noise Control Engineering, Progress in Noise Control for Industry p 763-766 1994
 Avail: Issuing Activity (Inst. of Noise Control Engineering, Noise Control Foundation, P.O. Box 2469 Arlington Branch, Poughkeepsie, NY 12603)

The question, 'Does military aircraft noise exposure affect residential property values in the vicinity of Air Force bases?', can be asked and answered with varying degrees of generality and tolerable errors of inference. Definitive answers are difficult to develop because the question itself may not be meaningful in some circumstances; property values are affected by many factors other than aircraft noise which can fluctuate greatly in different areas and during different time periods; credible attribution of causality for changes in property values uniquely to aircraft noise requires many costly study design measures; and prior findings suggest that if a relationship exists, it is not a large or especially strong one. Thus, evidence of a simple geographic association between aircraft noise exposure and residential property values does not provide a conclusive answer to the question. In an effort to develop more compelling evidence, the US Air Force is planning to compare historical records of sale prices of properties in areas of differential aircraft noise exposure during specific time periods with predictions of sale prices derived from a validated statistical model of residential property values. Author

N95-11311# Spectrum Sciences and Software, Inc., Fort Walton Beach, FL.
INTEGRATING NOISEMAP WITH THE GEOGRAPHIC RESOURCE ANALYSIS SUPPORT SYSTEM (GRASS) TO ENHANCE ENVIRONMENTAL IMPACT ASSESSMENTS AND LAND USE COMPATIBILITY STUDIES
 KENNETH SHEPARDSON In Inst. of Noise Control Engineering, Noise Control 1994; Proceedings of the 1994 National Conference on Noise Control Engineering, Progress in Noise Control for Industry

p 767-770 1994
 Avail: Issuing Activity (Inst. of Noise Control Engineering, Noise Control Foundation, P.O. Box 2469 Arlington Branch, Poughkeepsie, NY 12603)

The integration of the Geographic Resources Analysis Support System (GRASS) with noise models such as NOISEMAP and the Integrated Noise Model (INM) enhances the ability to calculate the impacts of flight operations on the surrounding community and the environment. A geographic information system (GIS) such as GRASS provides the tools necessary to perform complex noise analyses in a short period of time which in turn saves money. Additionally, because impact of noise levels on a study area can be run in a short time, alternative noise cases can be compared to see how modification in flight operations change noise impacts. This approach allows the military installation to adjust operations in order to decrease noise impacts and still fulfill its mission. Derived from text

N95-11319# Istanbul Univ. (Turkey). Faculty of Architecture.
AT ISTANBUL-ATATURK AIRPORT MEASUREMENT AND ANALYSIS OF NOISE IN DUE OF TAKE-OFF TIME
 SEVTAP YILMAZ DEMIRKALE In Inst. of Noise Control Engineering, Noise Control 1994; Proceedings of the 1994 National Conference on Noise Control Engineering, Progress in Noise Control for Industry p 941-946 1994
 Avail: Issuing Activity (Inst. of Noise Control Engineering, Noise Control Foundation, P.O. Box 2469 Arlington Branch, Poughkeepsie, NY 12603)

The topics covered include the following: (1) determination of noise occurring during run-up operations of aircraft; (2) determination of environmental factors on the propagation of the noise occurring due to run-up operations; (3) determination of noise measurement point at Istanbul Ataturk Airport and apparatus used for measurement; and (4) evaluation of noise measured during take-off times. Author

N95-11320# Mestre Greve Associates, Newport Beach, CA.
DETERMINING THE EFFECTS OF ALTERNATIVE DEPARTURE CUTBACK ALTITUDES AND POWER SETTINGS: A CASE STUDY, JOHN WAYNE AIRPORT
 VINCENT MESTRE In Inst. of Noise Control Engineering, Noise Control 1994; Proceedings of the 1994 National Conference on Noise Control Engineering, Progress in Noise Control for Industry p 947-952 1994
 Avail: Issuing Activity (Inst. of Noise Control Engineering, Noise Control Foundation, P.O. Box 2469 Arlington Branch, Poughkeepsie, NY 12603)

This paper provides only one example of the many aircraft and procedures evaluated as part of the JWA demonstration. Aircraft included in the analysis are the B757, B737, A320, MD-80, and the BAe-146. The measurement database provided an excellent basis for comparing departure procedures and for developing the departure profiles used in the noise contour model. The net result was that NoiseMap generated CNEL contours matched measurement data to within 1 dBA (0.5 dBA for close in measurement points). It is somewhat obvious that cutbacks at altitudes lower than normal or to lower power settings than typical will produce noise benefits near the cutback point but that resulting lower altitudes associated with early and/or deep cutbacks will result in higher noise levels farther down the flight track. It is not obvious where the noise benefits and increases will occur. These in fact vary by aircraft type and by procedure and vary over a fairly large range. Given that noise sensitive areas are geographically fixed and departure cutback benefit areas vary by aircraft and procedure over a large area, there may be only very limited opportunities to use this technique for noise abatement procedures without concomitant noise increases in downstream neighborhoods. Author

N95-11321# Brown-Buntin Associates, Inc., Visalia, CA.
INM CONTOUR VALIDATION: A CASE STUDY
 ROBERT E. BROWN In Inst. of Noise Control Engineering, Noise Control 1994; Proceedings of the 1994 National Conference on Noise Control Engineering, Progress in Noise Control for Industry

16 PHYSICS

p 953-958 1994

Avail: Issuing Activity (Inst. of Noise Control Engineering, Noise Control Foundation, P.O. Box 2469 Arlington Branch, Poughkeepsie, NY 12603)

Although aircraft noise modeling methods have become more sophisticated over the years, and the potential for accurate predictions of aircraft noise exposure has been enhanced, validation based upon noise measurements conducted within the airport environs remains one of the best ways for gaining public acceptance of noise modeling efforts. When short-term noise monitoring is used as the basis for validation, care must be exercised to ensure that annual average runway use and other seasonal airport operational factors are accounted for when measured and predicted aircraft DNL values are compared. The noise monitoring program described by this paper for McCarran International Airport was found to be an effective public relations tool, and the validated noise exposure maps may be used by the airport operator with confidence in the Part 150 noise compatibility planning process.

Author

N95-11322# Wyle Labs., Inc., Arlington, VA.

NOISE MODELING FOR MOAS AND RANGES

MICHAEL J. LUCAS and ROBERT A. LEE In Inst. of Noise Control Engineering, Noise Con 1994: Proceedings of the 1994 National Conference on Noise Control Engineering, Progress in Noise Control for Industry p 959-964 1994 Sponsored by AFSC

Avail: Issuing Activity (Inst. of Noise Control Engineering, Noise Control Foundation, P.O. Box 2469 Arlington Branch, Poughkeepsie, NY 12603)

Whenever there is a reallocation of DOD fixed- or rotary-wing aircraft or a change in the use of the airspace requirements, either an Environmental Assessment or an Environmental Impact Statement must be prepared. These environmental studies require an analysis of the noise impacts resulting from aircraft operations surrounding the airports and under Military Training Routes (MTR's), Military Operating Areas (MOA's), and Ranges. NOISEMAP and ROUTEMAP were developed for the purpose of estimating the noise levels around military airports and under MTR's. Neither of these programs is suitable for estimating noise levels under MOA's or Ranges. MR NMAP is a PC-based computer model that has been developed to calculate the noise levels under MOA's and ranges. The program calculates L(sub dn), CNEL, L(sub eq), SEL, L(sub max), and where appropriate L(sub dnmr). The program output is a tabular form or in graphics suitable for inclusion in reports. The computer program is designed for use by environmental planning personnel who are familiar with MOA and range operations and with noise, but are not necessarily expert. The program will be widely distributed to DOD planners and contractors that have a requirement to make noise estimates. A companion graphical user interface (GUI) computer program called MR OPS has been developed that allows the user to draw the airspace, specify areas of high/medium/low activity, and draw the specific flight tracks for bombing runs and military training routes. MR OPS writes an ASCII file that is read by MR NMAP. Contained in this ASCII file is the operation data and keywords that control the computational features in MR NMAP. MR NMAP is written in FORTRAN; executable versions are available under DOS, Windows, and Windows NT. MR OPS is written in the C programming language and will run under Windows and Windows NT.

Author

N95-11323# Spectrum Sciences and Software, Inc., Fort Walton Beach, FL.

MOAMAP: A MODEL THAT COMBINES SEVERAL DIFFERENT KINDS OF AIRCRAFT OPERATIONS

RODOLFO T. ARRIETA and LARRY MCGLOTHLIN In Inst. of Noise Control Engineering, Noise Con 1994: Proceedings of the 1994 Na-

tional Conference on Noise Control Engineering, Progress in Noise Control for Industry p 965-968 1994

Avail: Issuing Activity (Inst. of Noise Control Engineering, Noise Control Foundation, P.O. Box 2469 Arlington Branch, Poughkeepsie, NY 12603)

The United States Air Force engages in several different types of operations in Military Operating Areas (MOA's). These air combat training scenarios range from simple familiarization exercises to complex Air Combat Manuevering (ACM). The airspace planner must not only determine the effect of individual events on the noise environment under a MoA but they must also be able to address the variability inherent in this type of operating area. Issues which complicate the simulation of the noise environment in such an area are the possibility of sonic booms occurring during certain types of training such as ACM, and the variation in flying procedures from MoA to MOA. The MOAMAP program addresses all these. MOAMAP is a noise model that uses a stochastic kinematic simulation of aircraft operations to create a three dimensional probability density function (PDF) for the aircraft position. This PDF determines the likelihood that an aircraft will be found at a particular spot inside a predefined polygon such as a Military Operations Area (MOA) or an ellipse inscribed on the surface of the earth. The model does not assume any particular map projection and the noise calculations are simply based on a rectangular grid. The MOAMAP program is composed of several modules that simulate different aspects of a MOA or other operating area where the variability of the noise sources in both time and space preclude using other available noise models.

Author

N95-11324# Harris, Miller, Miller and Hanson, Inc., Lexington, MA.

THE PRESENT AND FUTURE OF AIRCRAFT NOISE MODELS: A USER'S PERSPECTIVE

KATE M. S. LARSON In Inst. of Noise Control Engineering, Noise Con 1994: Proceedings of the 1994 National Conference on Noise Control Engineering, Progress in Noise Control for Industry p 969-974 1994

Avail: Issuing Activity (Inst. of Noise Control Engineering, Noise Control Foundation, P.O. Box 2469 Arlington Branch, Poughkeepsie, NY 12603)

The art of modeling aircraft noise has evolved to the point where various separate models, combined, can provide excellent approximations of actual noise environments. The premise of this paper is that a single comprehensive aircraft noise model could provide the flexibility to model any aircraft noise situation. Such a model would embody the best features of each of the major models currently in use. There are five major aircraft noise models available today. Two of these models, the FAA's Integrated Noise Model (INM) and the Air Force's NOISEMAP, are primarily for modeling subsonic fixed wing aircraft operations at civilian and military airports, respectively. The FAA's Helicopter Noise Model (HNM) is used for modeling rotary wing aircraft flights. In addition, three other Air Force models are available for use in special situations. BOOMMAP is used for modeling supersonic aircraft; MOAMAP is used for modeling noise from flights in Military Operating Areas (MOA's); and ROUTEMAP is used for modeling noise from operations along Military Training Routes (MTR's). Users who are familiar with more than one of these models often find situations in which none of the available models provides all the required functionality, but one must be chosen over the others, or the outputs of two or more models must be combined. Unfortunately, the models are not designed to allow easy combination of the outputs. This paper compares the strengths and weaknesses of each of the three primary models (INM, NOISEMAP, and HNM), from the user's perspective, and points the way towards the development of one comprehensive national aircraft noise model. The author believes that such a model would logically be an evolution of the most widely adopted current model, the INM.

Author

17

SOCIAL SCIENCES

Includes social sciences (general); administration and management; documentation and information science; economics and cost analysis; law and political science; and urban technology and transportation.

N95-10873*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
FORMAL DESIGN AND VERIFICATION OF A RELIABLE COMPUTING PLATFORM FOR REAL-TIME CONTROL (PHASE 3 RESULTS)

RICKY W. BUTLER, BEN L. DIVITO, and C. MICHAEL HOLLOWAY
 Aug. 1994 112 p

(Contract RTOP 505-64-50-03)

(NASA-TM-109140; NAS 1.15:109140) Avail: CASI HC A06/MF A02

In this paper the design and formal verification of the lower levels of the Reliable Computing Platform (RCP), a fault-tolerant computing system for digital flight control applications, are presented. The RCP uses NMR-style redundancy to mask faults and internal majority voting to flush the effects of transient faults. Two new layers of the RCP hierarchy are introduced: the Minimal Voting refinement (DA_minv) of the Distributed Asynchronous (DA) model and the Local Executive (LE) Model. Both the DA_minv model and the LE model are specified formally and have been verified using the Ehdn verification system. All specifications and proofs are available electronically via the Internet using anonymous FTP or World Wide Web (WWW) access. Author

19

GENERAL

N95-10750* National Aeronautics and Space Administration. Hugh L. Dryden Flight Research Center, Edwards, CA.

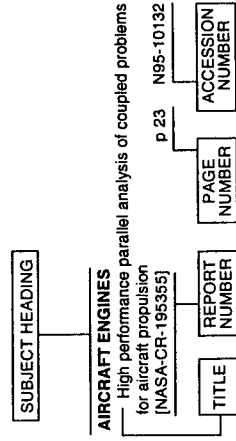
DRYDEN SUMMER 1994 UPDATE (Videotape)

8 Jul. 1994 Videotape: 17 min. playing time, in color, with sound (NASA-TM-104305; NONP-NASA-VT-94-23650) Avail: CASI VHS A01/BETA A22

This video presents a complete, technically detailed report on all Dryden projects, achievements, and employee activities for 1994.

DFRC

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A

- ABSORBERS (EQUIPMENT)**
Adaptive tuned vibration absorbers: Tuning laws, tracking agility, sizing, and physical implementations p 25 N95-11280
- ACCELERATED LIFE TESTS**
Micro-measurements of mechanical properties for adhesives and composites using digital imaging technology [NASA-CR-196111] p 22 N95-10231
- ACCELEROMETERS**
Effects of vibration on inertial wind-tunnel model attitude measurement devices [NASA-TM-109083] p 21 N95-11466
- ACCURACY**
Dryden lectureship in research, a perspective on CFD validation [AIAA PAPER 93-0002] p 3 A95-60180
Accuracy enhancements for overset grids using a defect correction approach [AIAA PAPER 94-0523] p 3 A95-60181
- ACOUSTIC COUPLING**
Achievements and tasks for active noise control p 29 N95-11270
- ACOUSTIC EXCITATION**
A theoretical analysis of airborne sound transfer for a resiliently mounted machine to its foundation p 30 N95-11304
Effect of constraining layer stiffness on performance of damping tile materials using finite element modeling with Rayleigh integral p 30 N95-11306
- ACOUSTICS**
Active control of interior noise in a business jet using piezoceramic actuators p 29 N95-11276
Adaptive tuned vibration absorbers: Tuning laws, tracking agility, sizing, and physical implementations p 25 N95-11280

- ACTIVE CONTROL**
Noise Con 1994: Proceedings of the 1994 National Conference on Noise Control Engineering. Progress in Noise Control for Industry p 28 N95-11259
Achievements and tasks for active noise control p 29 N95-11270
Active control of complex noise problems using a broadband, multichannel controller p 29 N95-11271
Active control of turbomachine discrete tones p 29 N95-11275
Active control of interior noise in a business jet using piezoceramic actuators p 29 N95-11276
Adaptive tuned vibration absorbers: Tuning laws, tracking agility, sizing, and physical implementations p 25 N95-11280
Broadband, wide-area active control of sound radiated from vibrating structures using local surface-mounted radiation suppression devices p 30 N95-11283
- ACTUATORS**
Achievements and tasks for active noise control p 29 N95-11270
Active control of interior noise in a business jet using piezoceramic actuators p 29 N95-11276
Adaptive tuned vibration absorbers: Tuning laws, tracking agility, sizing, and physical implementations p 25 N95-11280
- ADA (PROGRAMMING LANGUAGE)**
Advanced distributed simulation technology advanced rotary wing aircraft. Software reusability report [ADA-280434] p 20 N95-10354
- ADAPTIVE CONTROL**
Active control of complex noise problems using a broadband, multichannel controller p 29 N95-11271
Analytical investigation of adaptive control of radiated inlet noise from turbofan engines p 30 N95-11277
On the use of controls for subsonic transport performance improvement: Overview and future directions [NASA-TM-4605] p 10 N95-11408
- ADDITIONS**
Programmed ignition of metal compounds in a scramjet p 16 N95-10466
- ADHESION**
Micro-measurements of mechanical properties for adhesives and composites using digital imaging technology [NASA-CR-196111] p 22 N95-10231
- ADHESIVES**
Micro-measurements of mechanical properties for adhesives and composites using digital imaging technology [NASA-CR-196111] p 22 N95-10231
- AEROACOUSTICS**
Aeroacoustic probe design for microphone to reduce flow-induced self-noise p 19 A95-60163
[AIAA PAPER 93-4343]
An experimental investigation of wing tip turbulence with applications to aerodynamic noise p 1 A95-60164
[AIAA PAPER 86-1918]
Oblique incidence sound absorption of porous materials covered by perforated metal and exposed to tangential airflow [HTN-94-00681] p 19 A95-60165
On the scaling of small-scale jet noise to large scale [AIAA PAPER 92-02109] p 27 A95-60166
Recent advances in Euler and Navier-Stokes methods for calculating helicopter rotor aerodynamics and acoustics [HTN-94-00686] p 2 A95-60169
Study of noise on a small-scale hovering tilt rotor [HTN-94-00712] p 5 A95-60190
Effect of wind tunnel acoustic modes on linear oscillating cascade aerodynamics p 14 A95-60199
[HTN-94-00760]
Empirical refinements to boundary layer transition noise models p 28 N95-11262
- AERODYNAMIC CHARACTERISTICS**
Effect of leading- and trailing-edge flaps on clipped delta wings with and without wing camber at supersonic speeds [NASA-TM-4542] p 5 N95-10028

- An aerodynamic analysis of a mixed flow turbine [NASA-TM-106674] p 15 N95-10153
Flow-visualization study of the X-29A aircraft at high angles of attack using a 1/48-scale model [NASA-TM-104268] p 8 N95-10858
- AERODYNAMIC CONFIGURATIONS**
Accuracy enhancements for overset grids using a defect correction approach p 3 A95-60181
[AIAA PAPER 94-0523]
A comparison of turbulence models in computing multi-element airfoil flows p 4 A95-60185
[AIAA PAPER 94-0291]
Study of noise on a small-scale hovering tilt rotor p 5 A95-60190
[HTN-94-00712]
Effect of leading- and trailing-edge flaps on clipped delta wings with and without wing camber at supersonic speeds [NASA-TM-4542] p 5 N95-10028
- AERODYNAMIC DRAG**
Wing download reduction using vortex trapping plates [HTN-94-00710] p 4 A95-60188
An assessment of upper surface blowing for the reduction of tilt rotor download p 5 A95-60189
[HTN-94-00711]
Aerodynamic interactions between a rotor and wing in hover p 5 A95-60192
[HTN-94-00714]
- AERODYNAMIC FORCES**
Flutter analysis of supersonic axial flow cascades using a higher resolution Euler solver. Part 1: Formulation and validation [NASA-TM-105798] p 23 N95-10244
- AERODYNAMIC INTERFERENCE**
Comprehensive aeromechanics analysis of complex rotorcraft using 2GCHAS p 2 A95-60174
[HTN-94-00695]
First level release of 2GCHAS for comprehensive helicopter analysis - a status report p 2 A95-60176
[HTN-94-00697]
Numerical simulation of a complete STOVL aircraft in ground effect p 4 A95-60187
[AIAA PAPER 93-4880]
- AERODYNAMIC NOISE**
Comprehensive aeromechanics analysis of complex rotorcraft using 2GCHAS p 2 A95-60174
[HTN-94-00695]
First level release of 2GCHAS for comprehensive helicopter analysis - a status report p 2 A95-60176
[HTN-94-00697]
Fan noise research at NASA p 28 N95-11260
Empirical refinements to boundary layer transition noise models p 28 N95-11262
Analytical investigation of adaptive control of radiated inlet noise from turbofan engines p 30 N95-11277
- AERODYNAMIC STABILITY**
Comprehensive aeromechanics analysis of complex rotorcraft using 2GCHAS p 2 A95-60174
[HTN-94-00695]
First level release of 2GCHAS for comprehensive helicopter analysis - a status report p 2 A95-60176
[HTN-94-00697]
Dynamic stall of an oscillating wing. Part 1: Evaluation of turbulence models p 3 A95-60184
[AIAA PAPER 93-3403]
Aeroelastic tailoring research [PB94-180031] p 6 N95-10135
- AERODYNAMIC STALLING**
Interferometry and computational studies of an oscillating airfoil and compressible dynamic stall flow field p 3 A95-60182
[HTN-94-00703]
Oscillating airfoil compressible dynamic stall studies [HTN-94-00704] p 3 A95-60183

- Dynamic stall of an oscillating wing. Part 1: Evaluation of turbulence models p 3 A95-60184
[AIAA PAPER 93-3403]
- LDV measurements in dynamically separated flows p 5 A95-60191
[ISBN 0-8194-1311-9]
- A study of compressibility effects on dynamic stall of rapidly pitching airfoils p 5 A95-60193
[HTN-94-00715]
- AERODYNAMICS**
- Computational fluid dynamics uses in fluid dynamics/aerodynamics education p 8 N95-10847
[NASA-TM-108834]
- Potential impacts of advanced aerodynamic technology on air transportation system productivity p 10 N95-11489
[NASA-TM-109154]
- AEROELASTICITY**
- Comprehensive aeromechanics analysis of complex rotorcraft using 2GCHAS p 2 A95-60174
[HTN-94-00695]
- First level release of 2GCHAS for comprehensive helicopter analysis - a status report p 2 A95-60176
[HTN-94-00697]
- Aeroelastic tailoring research p 6 N95-10135
[PB94-180031]
- Computations of unsteady aerodynamic loads around oscillating wings. Part 1: Formulation p 7 N95-10136
[PB94-180049]
- Computations of unsteady aerodynamic loads around oscillating wings. Part 2: Computed results and discussions p 7 N95-10137
[PB94-180056]
- Flutter analysis of supersonic axial flow cascades using a high resolution Euler solver. Part 1: Formulation and validation p 23 N95-10244
[NASA-TM-105798]
- The use of the Regier number in the structural design with flutter constraints p 13 N95-11465
[NASA-TM-109128]
- AERONAUTICAL ENGINEERING**
- Drayden summer 1994 update p 33 N95-10750
[NASA-TM-104305]
- AEROSPACE ENGINEERING**
- Activities of Mitsubishi Heavy Industries Ltd. p 22 N95-10085
[PB94-179694]
- AEROSPACE PLANES**
- Aero-Space Plane: Flexible access to space p 22 N95-10553
[NASA-TM-109904]
- AEROTHERMOCHEMISTRY**
- Computation of nonequilibrium viscous flows in arc-jet wind tunnel nozzles p 2 A95-60173
[AIAA PAPER 94-0254]
- AEROTHERMODYNAMICS**
- Visualization of one-dimensional flow processes in a dual-mode scramjet engine p 15 N95-10465
- AGGLOMERATION**
- Agglomeration multigrad for viscous turbulent flows p 8 N95-10848
[NASA-CR-194953]
- AIR BREATHING ENGINES**
- Application of scramjet engine technology to the design of ram accelerator projectiles p 19 N95-10282
[NASA-TM-108837]
- AIR NAVIGATION**
- Design and flight evaluation of an integrated navigation and near-terrain helicopter guidance system for night-time and adverse weather operations p 11 N95-10846
[NASA-TM-108837]
- AIR POLLUTION**
- Three dimensional model calculations of the global dispersion of high speed aircraft exhaust and implications for stratospheric ozone loss p 26 N95-10657
[NASA-TM-109154]
- Integrating NOISEMAP with the Geographic Resource Analysis Support System (GRASS) to enhance environmental impact assessments and land use compatibility studies p 31 N95-11311
- AIR TRANSPORTATION**
- The High Speed Research Program p 10 N95-10548
[NASA-TM-109869]
- Potential impacts of advanced aerodynamic technology on air transportation system productivity p 10 N95-11489
[NASA-TM-109154]
- AIRBORNE/SPACEBORNE COMPUTERS**
- Design and flight evaluation of an integrated navigation and near-terrain helicopter guidance system for night-time and adverse weather operations p 11 N95-10846
[NASA-TM-108837]
- Instructional control and part/whole-task training: A review of the literature and an experimental comparison of strategies applied to instructional simulation p 21 N95-10919
[AD-A280860]
- AIRCRAFT ACCIDENTS**
- The crash of Flight 232 p 11 N95-10737
[NASA-TM-104279]
- Plastic hinge modeling of structures p 24 N95-11168
[NIAR-94-14]

AIRCRAFT COMPARTMENTS

- Transmission loss characteristics of aircraft sidewall systems to control cabin interior noise p 28 N95-11261
- Active control of interior noise in a business jet using piezoceramic actuators p 29 N95-11276
- Broadband, wide-area active control of sound radiated from vibrating structures using local surface-mounted radiation suppression devices p 30 N95-11283

AIRCRAFT CONFIGURATIONS

- X-31 tailless testing p 13 N95-10751
[NASA-TM-104306]
- A user's manual for the method of moments Aircraft Modeling Code (AMC), version 2 p 24 N95-11252
[NASA-CR-196445]
- The present and future of aircraft noise models: A user's perspective p 32 N95-11324
- Potential impacts of advanced aerodynamic technology on air transportation system productivity p 10 N95-11489
[NASA-TM-109154]

AIRCRAFT CONSTRUCTION MATERIALS

- Activities of Mitsubishi Heavy Industries Ltd. p 22 N95-10085
[PB94-179694]
- Advanced composites structural concepts and materials technologies for primary aircraft structures. Structural response and failure analysis: ISPAN modules users manual p 12 N95-10242
[NASA-CR-4449]
- Advanced composites structural concepts and materials technologies for primary aircraft structures: Design/manufacturing concept assessment p 12 N95-10316
[NASA-CR-4447]
- Novel matrix resins for composites for aircraft primary structures, phase 1 p 23 N95-10318
[NASA-CR-189657]

AIRCRAFT CONTROL

- Design of a model following, state variable feedback controller for the X-14 VTOL aircraft p 16 A95-60168
[HTN-94-00685]
- Fly-By-Light/Power-By-Wire Requirements and Technology Workshop p 12 N95-10245
[NASA-CR-10108]
- F-15 Propulsion Controlled Aircraft (PCA) p 17 N95-10748
[NASA-TM-104303]
- High-Alpha Research Vehicle (HARV) longitudinal controller: Design, analyses, and simulation results p 17 N95-10860
[NASA-TP-3446]
- On the use of controls for subsonic transport performance improvement: Overview and future directions p 10 N95-11408
[NASA-TM-109950]
- STOVL Control Integration Program p 18 N95-11487
[NASA-CR-195358]

AIRCRAFT DESIGN

- Activities of Mitsubishi Heavy Industries Ltd. p 22 N95-10085
[PB94-179694]
- High speed civil transport: Sonic boom softening and aerodynamic optimization p 28 N95-11192
[NASA-CR-196397]
- ACSNT inner loop flight control design study p 17 N95-11223
[NASA-CR-196316]
- General Aviation Task Force report p 1 N95-11463
[NASA-TM-109128]
- The use of the Regier number in the structural design with flutter constraints p 13 N95-11465
[NASA-TM-109128]

AIRCRAFT ENGINES

- High performance parallel analysis of coupled problems for aircraft propulsion p 23 N95-10132
[NASA-CR-195355]
- NASA Lewis Propulsion Systems Laboratory customer guide manual p 21 N95-10822
[NASA-TM-106569]
- JPRS report: Science and technology. Central Eurasia: Engineering and equipment. Gas dynamics of supersonic shortened nozzles p 22 N95-10931
[JPRS-UST-94-003-L]
- Noise Con 1994: Proceedings of the 1994 National Conference on Noise Control Engineering. Progress in Noise Control for Industry p 28 N95-11259
[LC-75-24750]
- Radiant energy measurements from a scaled jet engine axisymmetric exhaust nozzle for a baseline code validation case p 25 N95-11409
[NASA-TM-106686]

AIRCRAFT FUELS

- Programmed ignition of metal compounds in a scramjet p 16 N95-10466
- AIRCRAFT GUIDANCE**
- Research on an autonomous vision-guided helicopter [AIAA PAPER 94-1240-CP] p 18 N95-11510
- AIRCRAFT LANDING**
- Evaluation of F-18A approach and landing flying qualities using an in-flight simulator p 12 N95-10442
[CALSPAN-6241-F-1]

AIRCRAFT MAINTENANCE

- A generic telerobotics architecture for C-5 industrial processes p 27 N95-11529
[AIAA PAPER 94-1264-CP]

AIRCRAFT MANEUVERS

- High-angle-of-attack yawing moment asymmetry of the X-31 aircraft from flight test p 13 N95-11410
[NASA-CR-186030]

AIRCRAFT MODELS

- Advanced distributed simulation technology advanced rotary wing aircraft. System/segment specification. Volume 5: Simulation system module AH-64D kit p 20 N95-10353
[AD-A280433]
- Radio controlled for research p 17 N95-10717
[NASA-TM-104292]
- Computer-aided light sheet flow visualization using photogrammetry p 26 N95-10859
[NASA-TP-3416]
- The present and future of aircraft noise models: A user's perspective p 32 N95-11324
- STOVL Control Integration Program p 18 N95-11487
[NASA-CR-195358]

AIRCRAFT NOISE

- Noise Con 1994: Proceedings of the 1994 National Conference on Noise Control Engineering. Progress in Noise Control for Industry p 28 N95-11259
[LC-75-24750]
- Transmission loss characteristics of aircraft sidewall systems to control cabin interior noise p 28 N95-11261
- Achievements and tasks for active noise control p 29 N95-11270
- Active control of turbomachine discrete tones p 29 N95-11275
- Active control of interior noise in a business jet using piezoceramic actuators p 29 N95-11276
- Analytical investigation of adaptive control of radiated inlet noise from turbofan engines p 30 N95-11277
- Adaptive tuned vibration absorbers: Tuning laws, tracking agility, sizing, and physical implementations p 25 N95-11280
- A theoretical analysis of airborne sound transfer for a resiliently mounted machine to its foundation p 30 N95-11304
- Effect of constraining layer stiffness on performance of damping tile materials using finite element modeling with Rayleigh integral p 30 N95-11306
- 25 years of airport sound insulation programs p 31 N95-11307
- Assessing effects of military aircraft noise on residential property values near airbases p 31 N95-11310
- Integrating NOISEMAP with the Geographic Resource Analysis Support System (GRASS) to enhance environmental impact assessments and land use compatibility studies p 31 N95-11311
- At Istanbul-Ataturk Airport measurement and analysis of noise in due of take-off time p 31 N95-11319
- Determining the effects of alternative departure cutback altitudes and power settings: A case study, John Wayne Airport p 31 N95-11320
- INN contour validation: A case study p 31 N95-11321
- MOAMAP: A model that combines several different kinds of aircraft operations p 32 N95-11323
- The present and future of aircraft noise models: A user's perspective p 32 N95-11324
- Potential impacts of advanced aerodynamic technology on air transportation system productivity p 10 N95-11489
[NASA-TM-109154]

AIRCRAFT PERFORMANCE

- Extended cooperative control synthesis p 17 N95-10220
[NASA-TM-45611]
- On the use of controls for subsonic transport performance improvement: Overview and future directions p 10 N95-11408
[NASA-TM-4605]
- An application of virtual prototyping to the flight test and evaluation of an unmanned air vehicle p 14 N95-11595
[AD-A281749]

AIRCRAFT STRUCTURES

- Effect of passive venting on static pressure distributions in cavities at subsonic and transonic speeds p 6 N95-10029
[NASA-TM-4549]
- Activities of Mitsubishi Heavy Industries Ltd. p 22 N95-10085
[PB94-179694]
- Advanced composites structural concepts and materials technologies for primary aircraft structures: Structural response and failure analysis p 11 N95-10240
[NASA-CR-4446]
- Advanced composites structural concepts and materials technologies for primary aircraft structures. Structural response and failure analysis: ISPAN modules users manual p 12 N95-10242
[NASA-CR-4449]

- ANALOG CIRCUITS**
Broadband, wide-area active control of sound radiated from vibrating structures using local surface-mounted radiation suppression devices p 30 N95-11283
- ANGLE OF ATTACK**
An experimental investigation of wing tip turbulence with applications to aerodynamic p 1 A95-60164
[AIAA PAPER 86-1918]
Oscillating airfoil compressible dynamic stall studies [HTN-94-00704] p 3 A95-60183
A comparison of turbulence models in computing multi-element airfoil flows p 4 A95-60185
[AIAA PAPER 94-0291] p 4 A95-60185
LDV measurements in dynamically separated flows [ISBN 0-8194-1311-9] p 5 A95-60191
Effect of leading- and trailing-edge flaps on clipped delta wings with and without wing camber at supersonic speeds [NASA-TM-104283] p 13 N95-10711
Flow-visualization study of the X-29A aircraft at high angles of attack using a 1/48-scale model [NASA-TM-104268] p 8 N95-10858
Numerical simulation of the flow about the F-18 HARV at high angle of attack p 9 N95-10940
[NASA-CR-196396]
Computational analysis of forebody tangential slot blowing on the high alpha research vehicle [NASA-CR-196750] p 10 N95-11367
High-angle-of-attack yawing moment asymmetry of the X-31 aircraft from flight test p 13 N95-11410
[NASA-CR-186030] p 13 N95-11410
Effects of vibration on inertial wind-tunnel model attitude measurement devices p 21 N95-11466
- ANTENNA RADIATION PATTERNS**
A user's manual for the method of moments Aircraft Modeling Code (AMC), version 2 p 24 N95-11252
[NASA-CR-196445]
- APPLICATIONS PROGRAMS (COMPUTERS)**
Dryden lectureship in research, a perspective on CFD validation [AIAA PAPER 93-0002] p 3 A95-60180
Advanced composites structural concepts and materials technologies for primary aircraft structures. Structural response and failure analysis: ISPAN modules users manual [NASA-CR-4449] p 12 N95-10242
Modeling improvements and users manual for axial-flow turbine off-design computer code AXOD [NASA-CR-195370] p 8 N95-10853
ACS/NT inner loop flight control design study [NASA-CR-196316] p 17 N95-11223
A user's manual for the method of moments Aircraft Modeling Code (AMC), version 2 [NASA-CR-196445] p 24 N95-11252
- ARCHITECTURE (COMPUTERS)**
Advanced distributed simulation technology advanced rotary wing aircraft. Software reusability report [AD-A280434] p 20 N95-10354
Formal design and verification of a reliable computing platform for real-time control (phase 3 results) [NASA-TM-109140] p 33 N95-10873
- ARTIFICIAL INTELLIGENCE**
The 4-D approach to visual control of autonomous systems [AIAA PAPER 94-1243-CP] p 27 N95-11513
- ASYMMETRY**
High-angle-of-attack yawing moment asymmetry of the X-31 aircraft from flight test [NASA-CR-186030] p 13 N95-11410
- ATMOSPHERIC CHEMISTRY**
Three dimensional model calculations of the global dispersion of high speed aircraft exhaust and implications for stratospheric ozone loss p 26 N95-10657
- ATMOSPHERIC COMPOSITION**
Three dimensional model calculations of the global dispersion of high speed aircraft exhaust and implications for stratospheric ozone loss p 26 N95-10657
- ATMOSPHERIC CORRECTION**
Validation of empirical orbit error corrections using crossover difference differences p 25 A95-60227
[HTN-94-00912]
- AUTOMATIC CONTROL**
Optimum full-scale subsonic wind tunnel [AIAA PAPER 86-0732] p 18 A95-60161
- AUTONOMOUS NAVIGATION**
Research on an autonomous vision-guided helicopter [AIAA PAPER 94-1240-CP] p 18 N95-11510
- Advanced composites structural concepts and materials technologies for primary aircraft structures: Design/manufacturing concept assessment [NASA-CR-4447] p 12 N95-10316
- Novel matrix resins for composites for aircraft primary structures, phase 1 [NASA-CR-189657] p 23 N95-10318
- Broadband, wide-area active control of sound radiated from vibrating structures using local surface-mounted radiation suppression devices p 30 N95-11283
- Comments on the use of structureborne noise analysis for large commercial airplanes p 30 N95-11287
- Effect of constraining layer stiffness on performance of damping line materials using finite element modelling with Rayleigh integral p 30 N95-11306
- Potential impacts of advanced aerodynamic technology on air transportation system productivity [NASA-TM-109154] p 10 N95-11489
- AIRCRAFT SURVIVABILITY**
Advanced distributed simulation technology advanced rotary wing aircraft. System/segment specification. Volume 5: Simulation system module AH-64D kit [AD-A280433] p 20 N95-10353
- AIRCRAFT WAKES**
Airborne Windshear Detection and Warning Systems. Fifth and Final Combined Manufacturers' and Technologists' Conference, part 1 [NASA-CR-10139-PT-1] p 10 N95-10566
- Potential impacts of advanced aerodynamic technology on air transportation system productivity [NASA-TM-109154] p 10 N95-11489
- 3D visualization of unsteady 2D airplane wake vortices [NASA-TM-109154] p 10 N95-11489
- AIRFOIL OSCILLATIONS**
Interferometry and computational studies of an oscillating airfoil compressible dynamic stall flow field [HTN-94-00703] p 3 A95-60182
- Oscillating airfoil compressible dynamic stall studies [HTN-94-00704] p 3 A95-60183
- LDV measurements in dynamically separated flows [ISBN 0-8194-1311-9] p 5 A95-60191
- A study of compressibility effects on dynamic stall of rapidly pitching airfoils p 5 A95-60193
[HTN-94-00715]
- Effect of wind tunnel acoustic modes on linear oscillating cascade aerodynamics p 14 A95-60199
[HTN-94-00760]
- AIRFOILS**
Accuracy enhancements for overset grids using a defect correction approach [AIAA PAPER 94-0523] p 3 A95-60181
- A comparison of turbulence models in computing multi-element airfoil flows [AIAA PAPER 94-0291] p 4 A95-60185
- Navier-Stokes simulations of WECS airfoil flowfields [DE94-013341] p 7 N95-10226
- AIRLINE OPERATIONS**
Reanalysis of European flight loads data [AD-A282052] p 9 N95-11179
- Potential impacts of advanced aerodynamic technology on air transportation system productivity [NASA-TM-109154] p 10 N95-11489
- AIRPORTS**
25 years of airport sound insulation programs p 31 N95-11307
- At Istanbul-Ataturk Airport measurement and analysis of noise in the take-off time p 31 N95-11319
- Determining the effects of alternative departure cutback altitudes and power settings: A case study, John Wayne Airport p 31 N95-11320
- INM contour validation: A case study p 31 N95-11321
- Noise modeling for MOAs and ranges p 32 N95-11322
- AIRSPACE**
Noise modeling for MOAs and ranges p 32 N95-11322
- ALGORITHMS**
A comparison of three-dimensional nonequilibrium solution algorithms applied to hypersonic flows with stiff chemical source terms [AIAA PAPER 93-2861] p 4 A95-60186
- ALTIMETERS**
Validation of empirical orbit error corrections using crossover difference differences p 25 A95-60227
- ALTITUDE**
NASA Lewis Propulsion Systems Laboratory customer guide manual [NASA-TM-106569] p 21 N95-10822
- ALUMINUM**
Low frequency ultrasonic nondestructive inspection of aluminum/adhesive fuselage lap splices [DE94-014242] p 24 N95-11135

ANALOG CIRCUITS

Broadband, wide-area active control of sound radiated from vibrating structures using local surface-mounted radiation suppression devices p 30 N95-11283

ANGLE OF ATTACK

An experimental investigation of wing tip turbulence with applications to aerodynamic p 1 A95-60164
[AIAA PAPER 86-1918]
Oscillating airfoil compressible dynamic stall studies [HTN-94-00704] p 3 A95-60183
A comparison of turbulence models in computing multi-element airfoil flows p 4 A95-60185
[AIAA PAPER 94-0291] p 4 A95-60185
LDV measurements in dynamically separated flows [ISBN 0-8194-1311-9] p 5 A95-60191
Effect of leading- and trailing-edge flaps on clipped delta wings with and without wing camber at supersonic speeds [NASA-TM-104283] p 13 N95-10711
Flow-visualization study of the X-29A aircraft at high angles of attack using a 1/48-scale model [NASA-TM-104268] p 8 N95-10858
Numerical simulation of the flow about the F-18 HARV at high angle of attack p 9 N95-10940
[NASA-CR-196396]
Computational analysis of forebody tangential slot blowing on the high alpha research vehicle [NASA-CR-196750] p 10 N95-11367
High-angle-of-attack yawing moment asymmetry of the X-31 aircraft from flight test p 13 N95-11410
[NASA-CR-186030] p 13 N95-11410
Effects of vibration on inertial wind-tunnel model attitude measurement devices p 21 N95-11466

ANTENNA RADIATION PATTERNS

A user's manual for the method of moments Aircraft Modeling Code (AMC), version 2 p 24 N95-11252
[NASA-CR-196445]

APPLICATIONS PROGRAMS (COMPUTERS)

Dryden lectureship in research, a perspective on CFD validation [AIAA PAPER 93-0002] p 3 A95-60180
Advanced composites structural concepts and materials technologies for primary aircraft structures. Structural response and failure analysis: ISPAN modules users manual [NASA-CR-4449] p 12 N95-10242
Modeling improvements and users manual for axial-flow turbine off-design computer code AXOD [NASA-CR-195370] p 8 N95-10853
ACS/NT inner loop flight control design study [NASA-CR-196316] p 17 N95-11223
A user's manual for the method of moments Aircraft Modeling Code (AMC), version 2 [NASA-CR-196445] p 24 N95-11252

ARCHITECTURE (COMPUTERS)

Advanced distributed simulation technology advanced rotary wing aircraft. Software reusability report [AD-A280434] p 20 N95-10354
Formal design and verification of a reliable computing platform for real-time control (phase 3 results) [NASA-TM-109140] p 33 N95-10873

ARTIFICIAL INTELLIGENCE

The 4-D approach to visual control of autonomous systems [AIAA PAPER 94-1243-CP] p 27 N95-11513

ASYMMETRY

High-angle-of-attack yawing moment asymmetry of the X-31 aircraft from flight test [NASA-CR-186030] p 13 N95-11410

ATMOSPHERIC CHEMISTRY

Three dimensional model calculations of the global dispersion of high speed aircraft exhaust and implications for stratospheric ozone loss p 26 N95-10657

ATMOSPHERIC COMPOSITION

Three dimensional model calculations of the global dispersion of high speed aircraft exhaust and implications for stratospheric ozone loss p 26 N95-10657

ATMOSPHERIC CORRECTION

Validation of empirical orbit error corrections using crossover difference differences p 25 A95-60227
[HTN-94-00912]

AUTOMATIC CONTROL

Optimum full-scale subsonic wind tunnel [AIAA PAPER 86-0732] p 18 A95-60161

AUTONOMOUS NAVIGATION

Research on an autonomous vision-guided helicopter [AIAA PAPER 94-1240-CP] p 18 N95-11510

AVIATION METEOROLOGY

Airborne Windshear Detection and Warning Systems. Fifth and Final Combined Manufacturers' and Technologists' Conference, part 1 [NASA-CR-10139-PT-1] p 10 N95-10566

CHARACTERISTICS OF A DRY, PULSATING MICROBURST AT DENVER STAPLETON AIRPORT

Characteristics of a dry, pulsating microburst at Denver Stapleton Airport p 26 N95-10568
Future enhancements to ground-based microburst detection p 11 N95-10570

FLY-BY-LIGHT/POWER-BY-WIRE

Requirements and Technology Workshop [NASA-CP-10108] p 12 N95-10245
Design and flight evaluation of an integrated navigation and near-terrain helicopter guidance system for night-time and adverse weather operations [NASA-TM-108837] p 11 N95-10846

AXIAL FLOW

Flutter analysis of supersonic axial flow cascades using a high resolution Euler solver. Part 1: Formulation and validation [NASA-TM-105798] p 23 N95-10244

MODELING IMPROVEMENTS AND USERS MANUAL FOR AXIAL-FLOW TURBINE OFF-DESIGN COMPUTER CODE AXOD

Modeling improvements and users manual for axial-flow turbine off-design computer code AXOD [NASA-CR-195370] p 8 N95-10853

AEROACOUSTIC PROBE DESIGN FOR MICROPHONE TO REDUCE FLOW-INDUCED SELF-NOISE

Aeroacoustic probe design for microphone to reduce flow-induced self-noise [AIAA PAPER 93-4343] p 19 A95-60163

SCIENTIFIC BALLOONS

[NASA-TM-109907] p 7 N95-10556

EXACT DYNAMIC RESPONSES OF PERIODIC MULTI-SPAN BEAMS UNDER CONNECTED PRESSURE FIELDS

Exact dynamic responses of periodic multi-span beams under connected pressure fields p 25 N95-11288

ANALYSIS OF FLOW CHAMFELING NEAR THE WALL IN PACKED BEDS

Analysis of flow chamfeling near the wall in packed beds [HTN-94-00698] p 2 A95-60177

FAA VERTICAL FLIGHT BIBLIOGRAPHY

FAA vertical flight bibliography [DOT/FAA/RD-94/17] p 14 N95-11684

VALIDATION OF THE DYNAMIC RESPONSE OF A BLADE-ELEMENT UH-60 SIMULATION MODEL IN HOVERING FLIGHT

Validation of the dynamic response of a blade-element UH-60 simulation model in hovering flight [HTN-94-00663] p 18 A95-60155

STUDY OF NOISE ON A SMALL-SCALE HOVERING TILT ROTOR

Study of noise on a small-scale hovering tilt rotor [HTN-94-00712] p 5 A95-60190

COMPUTATIONAL ANALYSIS OF FOREBODY TANGENTIAL SLOT BLOWING ON THE HIGH ALPHA RESEARCH VEHICLE

Computational analysis of forebody tangential slot blowing on the high alpha research vehicle [NASA-CR-196750] p 10 N95-11367

LOW FREQUENCY ULTRASONIC NONDESTRUCTIVE INSPECTION OF ALUMINUM/ADHESIVE FUSELAGE LAP SPICES

Low frequency ultrasonic nondestructive inspection of aluminum/adhesive fuselage lap splices [DE94-014242] p 24 N95-11135

PROPULSION RESEARCH CONCERNING SFRRJ-MOTORS

Propulsion research concerning SFRRJ-motors [PB94-179520] p 14 N95-10083

AN EXPERIMENTAL INVESTIGATION OF WING TIP TURBULENCE WITH APPLICATIONS TO AERODYNAMIC

An experimental investigation of wing tip turbulence with applications to aerodynamic [AIAA PAPER 86-1918] p 1 A95-60164

OSCILLATING AIRFOIL COMPRESSIBLE DYNAMIC STALL STUDIES

Oscillating airfoil compressible dynamic stall studies [HTN-94-00704] p 3 A95-60183

NUMERICAL STUDY OF GORTLER INSTABILITY: APPLICATION TO THE DESIGN OF A QUIET SUPERSONIC WIND TUNNEL

Numerical study of Gortler instability: Application to the design of a quiet supersonic wind tunnel [PB94-184801] p 21 N95-10844

TRANSONIC FLIGHT TEST OF A LAMINAR FLOW LEADING EDGE WITH SURFACE EXCRESCENCES

Transonic flight test of a laminar flow leading edge with surface excrescences [NASA-TM-14597] p 9 N95-11156

EMPIRICAL REFINEMENTS TO BOUNDARY LAYER TRANSITION NOISE MODELS

Empirical refinements to boundary layer transition noise models p 28 N95-11262

APPLICATION OF SCRAMJET ENGINE TECHNOLOGY TO THE DESIGN OF RAM ACCELERATOR PROJECTILES

Application of scramjet engine technology to the design of ram accelerator projectiles p 19 N95-10282

ACTIVE CONTROL OF COMPLEX NOISE PROBLEMS USING A BROADBAND, MULTICHANNEL CONTROLLER

Active control of complex noise problems using a broadband, multichannel controller p 29 N95-11271

BROADBAND, WIDE-AREA ACTIVE CONTROL OF SOUND RADIATED FROM VIBRATING STRUCTURES USING LOCAL SURFACE-MOUNTED RADIATION SUPPRESSION DEVICES

Broadband, wide-area active control of sound radiated from vibrating structures using local surface-mounted radiation suppression devices p 30 N95-11283

BRUSH SEAL PERFORMANCE AND DURABILITY ISSUES BASED ON T-700 ENGINE TEST RESULTS

Brush seal performance and durability issues based on T-700 engine test results [NASA-TM-106502] p 22 N95-11483

BUFFETING

BUFFETING

Computations of unsteady aerodynamic loads around oscillating wings. Part 1: Formulation [PB94-180049] p 7 N95-10136

Computations of unsteady aerodynamic loads around oscillating wings. Part 2: Computed results and discussions [PB94-180056] p 7 N95-10137

Flow-visualization study of the X-29A aircraft at high angles of attack using a 1/48-scale model [NASA-TM-104268] p 8 N95-10858

BYPASS RATIO

Fan noise research at NASA p 28 N95-11260

BYPASSES

A full Navier-Stokes analysis of subsonic diffuser of a bifurcated 70/30 supersonic inlet for high speed civil transport application [NASA-TM-106637] p 8 N95-10820

C

C (PROGRAMMING LANGUAGE)

Noise modeling for MOAs and ranges p 32 N95-11322

C-5 AIRCRAFT

A generic telerobotics architecture for C-5 industrial processes [AIAA PAPER 94-1264-CP] p 27 N95-11529

CALIBRATING

Inlet flow test calibration for a small axial compressor facility. Part 1: Design and experimental results [NASA-TM-106719] p 16 N95-11005

CAMERAS

Computer-aided light sheet flow visualization using photogrammetry [NASA-TP-3416] p 26 N95-10859

CASCADE FLOW

Effect of wind tunnel acoustic modes on linear oscillating cascade aerodynamics [HTN-94-00760] p 14 A95-60199

Flutter analysis of supersonic axial flow cascades using a high resolution Euler solver. Part 1: Formulation and validation [NASA-TM-105798] p 23 N95-10244

CAVITIES

Effect of passive venting on static pressure distributions in cavities at subsonic and transonic speeds [NASA-TM-4549] p 6 N95-10029

CHANNEL FLOW

Analysis of flow channeling near the wall in packed beds [HTN-94-00698] p 2 A95-60177

CIVIL AVIATION

Micro-measurements of mechanical properties for adhesives and composites using digital imaging technology [NASA-CR-196111] p 22 N95-10231

A full Navier-Stokes analysis of subsonic diffuser of a bifurcated 70/30 supersonic inlet for high speed civil transport application [NASA-TM-106637] p 8 N95-10820

High speed civil transport: Sonic boom softening and aerodynamic optimization [NASA-CR-196397] p 28 N95-11192

COMBUSTION CHAMBERS

Experimental and analytical investigations of wave enhanced supersonic combustors [AIAA PAPER 89-2787] p 14 A95-60172

Propulsion research concerning SFRJ-motors [PB94-179520] p 14 N95-10083

Hydrocarbon-fueled ramjet/scramjet technology program, phase 2 extension [NASA-CR-189659] p 15 N95-10319

Visualization of one-dimensional flow processes in a dual-mode scramjet engine p 15 N95-10465

COMMAND LANGUAGES

A users manual for the method of moments Aircraft Modeling Code (AMC), version 2 [NASA-CR-196445] p 24 N95-11252

COMMERCIAL AIRCRAFT

Reanalysis of European flight loads data [AD-A282052] p 9 N95-11179

Comments on the use of structureborne noise analysis for large commercial airplanes p 30 N95-11287

General Aviation Task Force report [NASA-TM-109950] p 1 N95-11463

COMPOSITE MATERIALS

Advanced composites structural concepts and materials technologies for primary aircraft structures. Structural response and failure analysis: ISPAN modules users manual [NASA-CR-4449] p 12 N95-10242

COMPOSITE STRUCTURES

Aeroelastic tailoring research [PB94-180031] p 6 N95-10135

SUBJECT INDEX

Accuracy enhancements for overset grids using a defect correction approach [AIAA PAPER 94-0523] p 3 A95-60181

Numerical simulation of the flow about the F-18 HARV at high angle of attack [NASA-CR-196396] p 9 N95-10940

COMPUTER AIDED DESIGN

Advanced composites structural concepts and materials technologies for primary aircraft structures. Structural response and failure analysis: ISPAN modules users manual [NASA-CR-4449] p 12 N95-10242

High speed civil transport: Sonic boom softening and aerodynamic optimization [NASA-CR-196397] p 28 N95-11192

ACS/NT inner loop flight control design study [NASA-CR-196316] p 17 N95-11223

COMPUTER GRAPHICS

Computer-aided light sheet flow visualization using photogrammetry [NASA-TP-3416] p 26 N95-10859

COMPUTER PROGRAMS

F-15 Propulsion Controlled Aircraft (PCA) [NASA-TM-104303] p 17 N95-10748

Modeling improvements and users manual for axial-flow turbine off-design computer code AXOD [NASA-CR-195370] p 8 N95-10853

Radiant energy measurements from a scaled jet engine axisymmetric exhaust nozzle for a baseline code validation case [NASA-TM-106686] p 25 N95-11409

COMPUTER SYSTEMS PERFORMANCE

Steady and unsteady three-dimensional transonic flow computations by integral equation method [NASA-CR-196777] p 10 N95-11582

COMPUTER TECHNIQUES

Computer-aided light sheet flow visualization using photogrammetry [NASA-TP-3416] p 26 N95-10859

COMPUTER VISION

Research on an autonomous vision-guided helicopter [AIAA PAPER 94-1240-CP] p 18 N95-11510

The 4-D approach to visual control of autonomous systems [AIAA PAPER 94-1243-CP] p 27 N95-11513

COMPUTERIZED SIMULATION

Advanced distributed simulation technology advanced rotary wing aircraft. System/segment specification. Volume 1: Simulation system module [AD-A280238] p 20 N95-10350

Advanced distributed simulation technology advanced rotary wing aircraft. System/segment specification. Volume 3: Visual system module [AD-A280239] p 20 N95-10351

Advanced distributed simulation technology advanced rotary wing aircraft. System/segment specification. Volume 5: Simulation system module AH-64D kit [AD-A280433] p 20 N95-10353

Advanced distributed simulation technology advanced rotary wing aircraft. Software reusability report [AD-A280434] p 20 N95-10354

Computational fluid dynamics uses in fluid dynamics/aerodynamics education [NASA-TM-108834] p 8 N95-10847

Numerical simulation of the flow about the F-18 HARV at high angle of attack [NASA-CR-196396] p 9 N95-10940

CONFERENCES

Fly-By-Light/Power-By-Wire Requirements and Technology Workshop [NASA-CP-10108] p 12 N95-10245

Arborne Windshear Detection and Warning Systems. Fifth and Final Combined Manufacturers and Technologists' Conference, part 1 [NASA-CP-10139-PT-1] p 10 N95-10566

Noise Con 1994: Proceedings of the 1994 National Conference on Noise Control Engineering. Progress in Noise Control for Industry p 28 N95-11259

CONTAMINANTS

Three dimensional model calculations of the global dispersion of high speed aircraft exhaust and implications for stratospheric ozone loss p 26 N95-10657

CONTINUOUS NOISE

Comments on the use of structureborne noise analysis for large commercial airplanes p 30 N95-11287

CONTRAROTATING PROPELLERS

Effects of a forward-swept front rotor on the flowfield of a counterrotating propeller [NASA-TM-106671] p 7 N95-10148

CONTROL EQUIPMENT

Broadband, wide-area, active control of sound radiated from vibrating structures using local, surface-mounted radiation suppression devices p 30 N95-11283
Comments on the use of structureborne noise analysis for large commercial airplanes p 30 N95-11287

CONTROL SIMULATION

Instructional control and part/whole-task training: A review of the literature and an experimental comparison of strategies applied to instructional simulation [AD-A280860] p 21 N95-10919
Analytical investigation of adaptive control of radiated inlet noise from turbulent engines p 30 N95-11277

CONTROL SYSTEMS DESIGN

Flight test development and evaluation of a Kalman filter state estimator for low-altitude flight [HTN-94-00684] p 16 A95-60167
Design of a model following, state variable feedback controller for the X-14 VTOL aircraft [HTN-94-00685] p 16 A95-60168
Simulation development of a forward sensor-enhanced low-altitude guidance system [HTN-94-00688] p 17 A95-60170

Design and flight evaluation of an integrated navigation and near-terrain helicopter guidance system for night-time and adverse weather operations [NASA-TM-108837] p 11 N95-10846
High-Alpha Research Vehicle (HARV) longitudinal controller: Design, analyses, and simulation results [NASA-TP-3446] p 17 N95-10860
Application of an integrated methodology for propulsion and airframe control design to a STOVL aircraft [NASA-TM-106728] p 16 N95-11159
ACSNT inner loop flight control design study [NASA-CR-196316] p 17 N95-11223

Noise Con. 1994: Proceedings of the 1994 National Conference on Noise Control Engineering. Progress in Noise Control for Industry [LC-75-24750] p 28 N95-11259

Active control of complex noise problems using a broadband, multichannel controller p 29 N95-11271
Analytical investigation of adaptive control of radiated inlet noise from turbulent engines p 30 N95-11277
Adaptive tuned vibration absorbers: Tuning laws, tracking agility, sizing, and physical implementations p 25 N95-11280

Broadband, wide-area active control of sound radiated from vibrating structures using local, surface-mounted radiation suppression devices p 30 N95-11283
Comments on the use of structureborne noise analysis for large commercial airplanes p 30 N95-11287

On the use of controls for subsonic transport performance improvement: Overview and future directions [NASA-TM-4605] p 10 N95-11408

STOVL Control Integration Program [NASA-CR-195358] p 18 N95-11487

CONTROL THEORY

Extended cooperative control synthesis [NASA-TM-4561] p 17 N95-10220

CONTROLLERS

Design of a model following, state variable feedback controller for the X-14 VTOL aircraft [HTN-94-00685] p 16 A95-60168
Extended cooperative control synthesis [NASA-TM-4561] p 17 N95-10220
High-Alpha Research Vehicle (HARV) longitudinal controller: Design, analyses, and simulation results [NASA-TP-3446] p 17 N95-10860
Active control of complex noise problems using a broadband, multichannel controller p 29 N95-11271

CONVERGENT-DIVERGENT NOZZLES

Computation of nonequilibrium viscous flows in arc-jet wind tunnel nozzles [AIAA PAPER 94-0254] p 2 A95-60173

Two-dimensional converging-diverging rippled nozzles at transonic speeds --- performed in the Langley 16-Foot Transonic Tunnel [NASA-TP-3440] p 6 N95-10129

CORRECTION

Accuracy enhancements for overset grids using a defect correction approach [AIAA PAPER 94-0523] p 3 A95-60181

Effects of vibration on inertial wind-tunnel model attitude measurement devices [NASA-TM-109083] p 21 N95-11466

COST ANALYSIS

Optimum full-scale subsonic wind tunnel [AIAA PAPER 86-0732] p 18 A95-60161

Assessing effects of military aircraft noise on residential property values near airbases p 31 N95-11310

COUNTERMEASURES

Effect of passive venting on static pressure distributions in cavities at subsonic and transonic speeds [NASA-TM-4549] p 6 N95-10029

CRASH LANDING

The crash of Flight 232 [NASA-TM-104279] p 11 N95-10737

CRASHES

Plastic hinge modeling of structures [NIAR-94-14] p 24 N95-11168

CROSS FLOW

Jet to freestream velocity ratio computations for a jet in a crossflow [AIAA PAPER 93-4860] p 2 A95-60178

A full Navier-Stokes analysis of subsonic diffuser of a bifurcated 70/30 supersonic inlet for high speed civil transport application [NASA-TM-106637] p 8 N95-10820

CURVED PANELS

Advanced composites structural concepts and materials technologies for primary aircraft structures: Structural response and failure analysis p 11 N95-10240
[NASA-CR-4448]

D**DATA ACQUISITION**

Optimum full-scale subsonic wind tunnel [AIAA PAPER 86-0732] p 18 A95-60161

Low frequency ultrasonic nondestructive inspection of aluminum/adhesive fuselage lap splices [DE94-014242] p 24 N95-11135

Development of an experimental facility for analysis of rotorodynamic phenomena [AD-A281897] p 25 N95-11330

DATA BASES
Advanced distributed simulation technology advanced rotary wing aircraft. System/segment specification. Volume 3: Visual system module p 20 N95-10351

[AD-A280239] p 20 N95-10351

DATA REDUCTION
Reanalysis of European flight loads data [AD-A282052] p 9 N95-11179

DC 10 AIRCRAFT
The crash of Flight 232 [NASA-TM-104279] p 11 N95-10737

DELTA WINGS
Effect of leading- and trailing-edge flaps on clipped delta wings with and without wing camber at supersonic speeds [NASA-TM-4542] p 5 N95-10028

DESCRIPTIVE GEOMETRY
Computer-aided light sheet flow visualization using photogrammetry [NASA-TP-3416] p 26 N95-10859

DESIGN ANALYSIS
An aerodynamic analysis of a mixed flow turbine [NASA-TM-106674] p 15 N95-10153

High-Alpha Research Vehicle (HARV) longitudinal controller: Design, analyses, and simulation results [NASA-TP-3446] p 17 N95-10860

DIFFUSERS
A full Navier-Stokes analysis of subsonic diffuser of a bifurcated 70/30 supersonic inlet for high speed civil transport application [NASA-TM-106637] p 8 N95-10820

DIFFUSION
Agglomeration multigrid for viscous turbulent flows [NASA-CR-194953] p 8 N95-10848

DIFFUSION FLAMES
Theories of turbulent combustion in high speed flows [AD-A280933] p 23 N95-10535

DIGITAL COMPUTERS
Formal design and verification of a reliable computing platform for real-time control (phase 3 results) [NASA-TM-109140] p 33 N95-10873

DIGITAL ELECTRONICS
Formal design and verification of a reliable computing platform for real-time control (phase 3 results) [NASA-TM-109140] p 33 N95-10873

DIGITAL SYSTEMS
Micro-measurements of mechanical properties for adhesives and composites using digital imaging technology [NASA-CR-196111] p 22 N95-10231

Formal design and verification of a reliable computing platform for real-time control (phase 3 results) [NASA-TM-109140] p 33 N95-10873

DIGITAL TECHNIQUES
Computer-aided light sheet flow visualization using photogrammetry [NASA-TP-3416] p 26 N95-10859

DIMENSIONAL ANALYSIS
An aerodynamic analysis of a mixed flow turbine [NASA-TM-106674] p 15 N95-10153

DIRECTIONAL CONTROL
Effect of weak periodic pressure gradient on streamwise vortices near a wall p 29 N95-11263

EDUCATION

Computational analysis of forebody tangential slot blowing on the high alpha research vehicle p 10 N95-11367

[NASA-CR-196750]

DISCHARGE COEFFICIENT
Two-dimensional converging-diverging rippled nozzles at transonic speeds --- performed in the Langley 16-Foot Transonic Tunnel [NASA-TP-3440] p 6 N95-10129

DISPLAY DEVICES
Advanced distributed simulation technology advanced rotary wing aircraft. System/segment specification. Volume 3: Visual system module p 20 N95-10351

[AD-A280239]

DOPPLER RADAR
Vertical wind estimation from horizontal wind measurements p 26 N95-10567

Determining F-factor using ground-based Doppler radar. Validation and results p 11 N95-10571

DOWNWASH
Numerical simulation of a complete STOVL aircraft in ground effect [AIAA PAPER 93-4880] p 4 A95-60187

DRAW
Two-dimensional converging-diverging rippled nozzles at transonic speeds --- performed in the Langley 16-Foot Transonic Tunnel [NASA-TP-3440] p 6 N95-10129

DRAW COEFFICIENTS
Navier-Stokes simulations of WECS airflow flowfields [DE94-013341] p 7 N95-10226

DRAW REDUCTION
Wing download reduction using vortex trapping plates [HTN-94-00710] p 4 A95-60188

An assessment of upper surface blowing for the reduction of full rotor download [HTN-94-00711] p 5 A95-60189

Aerodynamic interactions between a rotor and wing in hover [HTN-94-00714] p 5 A95-60192

Effect of passive venting on static pressure distributions in cavities at subsonic and transonic speeds [NASA-TM-4549] p 6 N95-10029

DUCTED FLOW
An aerodynamic analysis of a mixed flow turbine [NASA-TM-106674] p 15 N95-10153

DUCTS
Active control of complex noise problems using a broadband, multichannel controller p 29 N95-11271

DURABILITY
Brush seal performance and durability issues based on T-700 engine test results [NASA-TM-106502] p 22 N95-11483

DYNAMIC CHARACTERISTICS
Comments on the use of structureborne noise analysis for large commercial airplanes p 30 N95-11287

DYNAMIC MODELS
Extended cooperative control synthesis [NASA-TM-4561] p 17 N95-10220

The 4-D approach to visual control of autonomous systems [AIAA PAPER 94-1243-CP] p 27 N95-11513

An application of virtual prototyping to the flight test and evaluation of an unmanned air vehicle [AD-A281748] p 14 N95-11595

DYNAMIC RESPONSE
Validation of the dynamic response of a blade-element UH-60 simulation model in hovering flight [HTN-94-00663] p 18 A95-60155

High performance parallel analysis of coupled problems for aircraft propulsion p 23 N95-10132

Exact dynamic responses of periodic multi-span beams under convected pressure fields p 25 N95-11288

Dynamic response of NASA Rotor Test Apparatus and Sikorsky S-76 hub mounted in the 80- by 120-Foot Wind Tunnel [NASA-TM-108847] p 25 N95-11389

DYNAMIC STABILITY
High-angle-of-attack yawing moment asymmetry of the X-31 aircraft from flight test [NASA-CR-186030] p 13 N95-11410

DYNAMIC STRUCTURAL ANALYSIS
Flutter analysis of supersonic axial flow cascades using a high resolution Euler solver. Part 1: Formulation and validation [NASA-TM-105798] p 23 N95-10244

Plastic hinge modeling of structures [NIAR-94-14] p 24 N95-11168

E

EDUCATION
Dryden overview for schools [NASA-TM-104282] p 21 N95-10710

- Dryden overview for schools
[NASA-TM-104302] p 21 N95-10747
- Computational fluid dynamics uses in fluid dynamics/aerodynamics education
[NASA-TM-108934] p 8 N95-10847
- ELECTROMAGNETIC INTERFERENCE**
Formal design and verification of a reliable computing platform for real-time control (phase 3 results)
[NASA-TM-109140] p 33 N95-10873
- ELECTROMAGNETIC SCATTERING**
A users manual for the method of moments Aircraft Modeling Code (AMC), version 2
[NASA-CR-196445] p 24 N95-11252
- ELECTRONIC CONTROL**
A programmable heater control circuit for spacecraft
[NASA-TM-108459] p 9 N95-11157
- ENGINE CONTROL**
STOVL Control Integration Program
[NASA-CR-195358] p 18 N95-11487
- ENGINE DESIGN**
Application of scramjet engine technology to the design of ram accelerator projectiles
[NASA Lewis Propulsion Systems Laboratory customer guide manual]
[NASA-TM-106569] p 21 N95-10822
- A theoretical analysis of airborne sound transfer for a resiliently mounted machine to its foundation
[NASA-TM-106569] p 30 N95-11304
- ENGINE INLETS**
Application of scramjet engine technology to the design of ram accelerator projectiles
[NASA Lewis Propulsion Systems Laboratory customer guide manual]
[NASA-TM-106569] p 21 N95-10822
- Analytical investigation of adaptive control of radiated inlet noise from turbofan engines
[NASA-CR-195358] p 30 N95-11277
- ENGINE NOISE**
On the scaling of small-scale jet noise to large scale
[AIAA PAPER 92-02109] p 27 A95-60166
- Near field noise prediction requirements
[ISVR-TR-234] p 27 N95-11166
- Noise Con 1994: Proceedings of the 1994 National Conference on Noise Control Engineering. Progress in Noise Control for Industry
[LC-75-24750] p 28 N95-11259
- Fan noise research at NASA
[NASA-TM-106569] p 28 N95-11260
- Active control of turbomachine discrete tones
[NASA-TM-106569] p 28 N95-11275
- Analytical investigation of adaptive control of radiated inlet noise from turbofan engines
[NASA-CR-195358] p 30 N95-11277
- A theoretical analysis of airborne sound transfer for a resiliently mounted machine to its foundation
[NASA-TM-106569] p 30 N95-11304
- At Istanbul-Ataturk Airport measurement and analysis of noise in due of take-off time
[NASA-TM-106569] p 31 N95-11319
- ENGINE TESTS**
Hydrocarbon-fueled ramjet/scramjet technology program, phase 2 extension
[NASA-CR-189659] p 15 N95-10319
- NASA Lewis Propulsion Systems Laboratory test article systems criteria
[NASA-TM-106589] p 20 N95-10446
- NASA Lewis Propulsion Systems Laboratory customer guide manual
[NASA-TM-106569] p 21 N95-10822
- Brush seal performance and durability issues based on T-700 engine test results
[NASA-TM-106502] p 22 N95-11483
- ENGINEERING MANAGEMENT**
NASA Lewis Propulsion Systems Laboratory test article systems criteria
[NASA-TM-106589] p 20 N95-10446
- ENTHALPY**
Numerical study of mixing in a high and low enthalpy supersonic test facility
[NASA-TM-106589] p 7 N95-10467
- ENVIRONMENT EFFECTS**
Integrating NOISEMAP with the Geographic Resource Analysis Support System (GRASS) to enhance environmental impact assessments and land use compatibility studies
[NASA-TM-106589] p 31 N95-11311
- ENVIRONMENT MANAGEMENT**
Noise modeling for MOAs and ranges
[NASA-TM-106589] p 32 N95-11322
- ENVIRONMENTAL SURVEYS**
Integrating NOISEMAP with the Geographic Resource Analysis Support System (GRASS) to enhance environmental impact assessments and land use compatibility studies
[NASA-TM-106589] p 31 N95-11311
- Noise modeling for MOAs and ranges
[NASA-TM-106589] p 32 N95-11322
- EPOXY RESINS**
Novel matrix resins for composites for aircraft primary structures, phase 1
[NASA-CR-189657] p 23 N95-10318

FAR FIELDS

- Analytical investigation of adaptive control of radiated inlet noise from turbofan engines
[NASA-TM-106589] p 30 N95-11277
- Exact dynamic responses of periodic multi-span beams under convected pressure fields
[NASA-TM-106589] p 25 N95-11288
- FAULT TOLERANCE**
Fly-By-Light/Power-By-Wire Requirements and Technology Workshop
[NASA-CR-10108] p 12 N95-10245
- Formal design and verification of a reliable computing platform for real-time control (phase 3 results)
[NASA-TM-109140] p 33 N95-10873
- FEEDBACK CONTROL**
Design of a model following, state variable feedback controller for the X-14 VTOL aircraft
[HTN-94-00685] p 16 A95-60168
- Extended cooperative control synthesis
[NASA-TM-4561] p 17 N95-10220
- High-Alpha Research Vehicle (HARV) longitudinal controller: Design, analyses, and simulation results
[NASA-TP-3446] p 17 N95-10860
- Analytical investigation of adaptive control of radiated inlet noise from turbofan engines
[NASA-CR-195358] p 30 N95-11277
- FIBER COMPOSITES**
Advanced composites structural concepts and materials technologies for primary aircraft structures: Design/manufacturing concept assessment
[NASA-CR-4447] p 12 N95-10316
- FINITE ELEMENT METHOD**
Advanced composites structural concepts and materials technologies for primary aircraft structures: Structural response and failure analysis
[NASA-CR-4448] p 11 N95-10240
- Advanced composites structural concepts and materials technologies for primary aircraft structures: Structural response and failure analysis: ISPAN modules users manual
[NASA-CR-4449] p 12 N95-10242
- Effect of constraining layer stiffness on performance of damping like materials using finite element modelling with Rayleigh integral
[NASA-CR-196749] p 9 N95-11366
- FINITE VOLUME METHOD**
Development of an upwind, finite-volume code with finite-rate chemistry
[NASA-CR-196749] p 9 N95-11366
- FIXED WINGS**
The present and future of aircraft noise models: A user's perspective
[NASA-CR-4449] p 32 N95-11324
- FLAME PROPAGATION**
Flame-spreading phenomena in the fin-slot region of a solid rocket motor
[NASA-CR-196749] p 23 N95-10296
- FLAMMABILITY**
Programmed ignition of metal compounds in a scramjet
[NASA-CR-196749] p 16 N95-10466
- FLIGHT ALTITUDE**
Determining the effects of alternative departure cutback altitudes and power settings: A case study, John Wayne Airport
[NASA-TM-4561] p 17 N95-10220
- FLIGHT CHARACTERISTICS**
Extended cooperative control synthesis
[NASA-TM-4561] p 17 N95-10220
- Evaluation of F-18A approach and landing flying qualities using an in-flight simulator
[CALSPAN-6241-F-1] p 12 N95-10442
- High-angle-of-attack yawing moment asymmetry of the X-31 aircraft from flight test
[NASA-CR-186030] p 13 N95-11410
- STOVL Control Integration Program
[NASA-CR-195358] p 18 N95-11487
- An application of virtual prototyping to the flight test and evaluation of an unmanned air vehicle
[AD-A281749] p 14 N95-11595
- FLIGHT CONDITIONS**
Hydrocarbon-fueled ramjet/scramjet technology program, phase 2 extension
[NASA-CR-189659] p 15 N95-10319
- FLIGHT CONTROL**
Flight test development and evaluation of a Kalman filter state estimator for low-altitude flight
[HTN-94-00684] p 16 A95-60167
- Simulation development of a forward sensor-enhanced low-altitude guidance system
[HTN-94-00688] p 17 A95-60170
- Evaluation of F-18A approach and landing flying qualities using an in-flight simulator
[CALSPAN-6241-F-1] p 12 N95-10442
- F-15 835 (HIDE) resource tape
[NASA-TM-104297] p 13 N95-10742
- F-15 Propulsion Controlled Aircraft (PCA)
[NASA-TM-104303] p 17 N95-10748
- On the use of controls for subsonic transport performance improvement: Overview and future directions
[NASA-TM-4605] p 10 N95-11408
- F-104 AIRCRAFT**
F-104 resource tape
[NASA-TM-104296] p 13 N95-10741
- F-15 AIRCRAFT**
F-15 835 (HIDE) resource tape
[NASA-TM-104297] p 13 N95-10742
- F-15 Propulsion Controlled Aircraft (PCA)
[NASA-TM-104303] p 17 N95-10748
- On the use of controls for subsonic transport performance improvement: Overview and future directions
[NASA-TM-4605] p 10 N95-11408
- F-16 AIRCRAFT**
Research excitation system flight testing
[NASA-TM-104289] p 13 N95-10715
- F-16X resource tape
[NASA-TM-104296] p 13 N95-10743
- F-18 AIRCRAFT**
Evaluation of F-18A approach and landing flying qualities using an in-flight simulator
[CALSPAN-6241-F-1] p 12 N95-10442
- F-18 HARV presentation for industry
[NASA-TM-104283] p 13 N95-10711
- F-18 high alpha research vehicle resource tape
[NASA-TM-104299] p 13 N95-10744
- Numerical simulation of the flow about the F-18 HARV at high angle of attack
[NASA-CR-196396] p 9 N95-10940
- Computational analysis of forebody tangential slot blowing on the high alpha research vehicle
[NASA-CR-196750] p 10 N95-11367
- F-8 AIRCRAFT**
Dryden and transonic research
[NASA-TM-104281] p 1 N95-10709
- FACILITIES**
Development of an experimental facility for analysis of rotodynamic phenomena
[AD-A281897] p 25 N95-11330
- FAILURE ANALYSIS**
Advanced composites structural concepts and materials technologies for primary aircraft structures: Structural response and failure analysis
[NASA-CR-4448] p 11 N95-10240
- Brush seal performance and durability issues based on T-700 engine test results
[NASA-TM-106502] p 22 N95-11483
- FAN BLADES**
Computational fluid dynamics study of the variable-pitch split-blade fan concept
[NASA-CR-189206] p 15 N95-10247
- Fan noise research at NASA
[NASA-TM-106569] p 28 N95-11260
- Analytical investigation of adaptive control of radiated inlet noise from turbofan engines
[NASA-TM-106569] p 30 N95-11277

F

Formal design and verification of a reliable computing platform for real-time control (phase 3 results)
[NASA-TM-109140] p 33 N95-10873

Application of an integrated methodology for propulsion and airframe control design to a STOVL aircraft
[NASA-TM-106729] p 16 N95-11159

ACS/NT inner loop flight control design study
[NASA-CR-196316] p 17 N95-11223

STOVL Control Integration Program
[NASA-CR-195358] p 18 N95-11487

Research on an autonomous vision-guided helicopter
[AIAA PAPER 94-1240-CP] p 18 N95-11510

FLIGHT HAZARDS

Airborne Windshear Detection and Warning Systems. Fifth and Final Combined Manufacturers' and Technologists' Conference, part 1
[NASA-CR-10139-PT-1] p 10 N95-10566

Vertical wind estimation from horizontal wind measurements
p 26 N95-10567

Characteristics of a dry, pulsating microburst at Denver Stapleton Airport
p 26 N95-10568

Future enhancements to ground-based microburst detection
p 11 N95-10570

Determining F-factor using ground-based Doppler radar: Validation and results
p 11 N95-10571

Potential impacts of advanced aerodynamic technology on air transportation system productivity
[NASA-TM-109154] p 10 N95-11489

FLIGHT OPERATIONS

Noise modeling for MOAs and ranges
p 32 N95-11322

MOAMAP: A model that combines several different kinds of aircraft operations
p 32 N95-11323

The present and future of aircraft noise models: A user's perspective
p 32 N95-11324

FLIGHT SIMULATION

Validation of the dynamic response of a blade-element UH-60 simulation model in hovering flight
[HTN-94-00663] p 18 A95-60155

Simulation development of a forward sensor-enhanced low-altitude guidance system
[HTN-94-00688] p 17 A95-60170

NASA Lewis Propulsion Systems Laboratory customer guide manual
[NASA-TM-106569] p 21 N95-10822

Instructional control and part/whole-task training: A review of the literature and an experimental comparison of strategies applied to instructional simulation
[AD-A280860] p 21 N95-10319

STOVL Control Integration Program
[NASA-CR-195358] p 18 N95-11487

FLIGHT SIMULATORS

Evaluation of simulation motion fidelity criteria in the vertical and directional axes
[HTN-94-00666] p 18 A95-60156

Advanced distributed simulation technology advanced rotary wing aircraft. Strawman verification and validation plan for the ARWA simulator system
[AD-A280237] p 19 N95-10349

Advanced distributed simulation technology advanced rotary wing aircraft. System/segment specification. Volume 1: Simulation system module
[AD-A280238] p 20 N95-10350

Advanced distributed simulation technology advanced rotary wing aircraft. System/segment specification. Volume 3: Visual system module
[AD-A280239] p 20 N95-10351

Advanced distributed simulation technology advanced rotary wing aircraft. System/segment specification. Volume 1: Simulation system module
[AD-A280238] p 20 N95-10350

Advanced distributed simulation technology advanced rotary wing aircraft. System/segment specification. Volume 3: Visual system module
[AD-A280239] p 20 N95-10351

Advanced distributed simulation technology advanced rotary wing aircraft. System/segment specification. Volume 5: Simulation system module AH-64D kit
[AD-A280433] p 20 N95-10353

FUSELAGES

Advanced composites structural concepts and materials technologies for primary aircraft structures: Structural response and failure analysis
[NASA-CR-44448] p 11 N95-10240

Advanced composites structural concepts and materials technologies for primary aircraft structures: Design/manufacturing concept assessment
[NASA-CR-44447] p 12 N95-10316

Comments on the use of structureborne noise analysis for large commercial airplanes
p 30 N95-11287

FOREBODIES

Aeroacoustic probe design for microphone to reduce flow-induced self-noise
[AIAA PAPER 93-4343] p 19 A95-60163

Computational analysis of forebody tangential slot blowing on the high alpha research vehicle
[NASA-CR-196750] p 10 N95-11367

High-angle-of-attack yawing moment asymmetry of the X-31 aircraft from flight test
[NASA-CR-186030] p 13 N95-11410

FREE FLOW

Jet to freestream velocity ratio computations for a jet in a crossflow
[AIAA PAPER 93-4860] p 2 A95-60178

FUEL COMBUSTION

Programmed ignition of metal compounds in a scramjet
p 16 N95-10466

FUEL INJECTION

Experimental and analytical investigations of wave enhanced supersonic combustors
[AIAA PAPER 89-2787] p 14 A95-60172

Hydrocarbon-fueled ramjet/scramjet technology program, phase 2 extension
[NASA-CR-189859] p 15 N95-10319

FUEL SYSTEMS

Advanced distributed simulation technology advanced rotary wing aircraft. System/segment specification. Volume 2: Flight station module
[AD-A280432] p 20 N95-10352

FULL SCALE TESTS

NASA Lewis Propulsion Systems Laboratory test article systems criteria
[NASA-TM-106589] p 20 N95-10446

FUNCTIONAL DESIGN SPECIFICATIONS

Advanced distributed simulation technology advanced rotary wing aircraft. Strawman verification and validation plan for the ARWA simulator system
[AD-A280237] p 19 N95-10349

Advanced distributed simulation technology advanced rotary wing aircraft. System/segment specification. Volume 1: Simulation system module
[AD-A280238] p 20 N95-10350

Advanced distributed simulation technology advanced rotary wing aircraft. System/segment specification. Volume 3: Visual system module
[AD-A280239] p 20 N95-10351

Advanced distributed simulation technology advanced rotary wing aircraft. System/segment specification. Volume 5: Simulation system module AH-64D kit
[AD-A280433] p 20 N95-10353

FUSELAGES

Advanced composites structural concepts and materials technologies for primary aircraft structures: Structural response and failure analysis
[NASA-CR-44448] p 11 N95-10240

Advanced composites structural concepts and materials technologies for primary aircraft structures: Design/manufacturing concept assessment
[NASA-CR-44447] p 12 N95-10316

Comments on the use of structureborne noise analysis for large commercial airplanes
p 30 N95-11287

G

GALERKIN METHOD

Agglomeration multigrid for viscous turbulent flows
[NASA-CR-194953] p 8 N95-10848

GAS DYNAMICS

JPRS report: Science and technology. Central Eurasia: Engineering and equipment. Gas dynamics of supersonic shortened nozzles
[JPRS-U5T-94-003-L] p 22 N95-10931

GAS INJECTION

Numerical study of mixing in a high and low enthalpy supersonic test facility
p 7 N95-10467

GAS TURBINE ENGINES

Effect of wind tunnel acoustic modes on linear oscillating cascade aerodynamics
[HTN-94-00760] p 14 A95-60199

NASA Lewis Propulsion Systems Laboratory customer guide manual
[NASA-TM-106569] p 21 N95-10822

Modeling improvements and users manual for axial-flow turbine off-design computer code AXOD
[NASA-CR-195370] p 8 N95-10853

Brush seal performance and durability issues based on T-700 engine test results
[NASA-TM-106502] p 22 N95-11483

Flow-visualization study of the X-29A aircraft at high angles of attack using a 1/48-scale model
[NASA-TM-104268] p 8 N95-10858

Transonic flight test of a laminar flow leading edge with surface excrescences
[NASA-TM-4597] p 9 N95-11158

High-angle-of-attack yawing moment asymmetry of the X-31 aircraft from flight test
[NASA-CR-186030] p 13 N95-11410

An application of virtual prototyping to the flight test and evaluation of an unmanned air vehicle
[AD-A281749] p 14 N95-11595

FLOW CHARACTERISTICS

The NASA Langley 8-foot Transonic Pressure Tunnel calibration
[NASA-TP-3437] p 8 N95-10739

Numerical study of Gortler instability: Application to the design of a quiet supersonic wind tunnel
[PB94-184801] p 21 N95-10844

FLOW DISTORTION

A full Navier-Stokes analysis of subsonic diffuser of a bifurcated 70/30 supersonic inlet for high speed civil transport application
[NASA-TM-106637] p 8 N95-10820

FLOW DISTRIBUTION

Interferometry and computational studies of an oscillating airfoil compressible dynamic stall flow field
[HTN-94-00703] p 3 A95-60182

Effect of passive venting on static pressure distributions in cavities at subsonic and transonic speeds
[NASA-TM-4549] p 6 N95-10029

Effects of a forward-swept front rotor on the flowfield of a counterrotation propeller
[NASA-TM-106671] p 7 N95-10148

Navier-Stokes simulations of WECS airfoil flowfields
[IDES94-013341] p 7 N95-10226

Application of scramjet engine technology to the design of ram accelerator projectiles
p 19 N95-10282

Inlet flow test calibration for a small axial compressor facility. Part 1: Design and experimental results
[NASA-TM-106719] p 16 N95-11005

FLOW EQUATIONS

Analysis of flow channeling near the wall in packed beds
[HTN-94-00698] p 2 A95-60177

High performance parallel analysis of coupled problems for aircraft propulsion
[NASA-CR-195355] p 23 N95-10132

FLOW GEOMETRY

Numerical simulation of the flow about the F-18 HARV at high angle of attack
[NASA-CR-196396] p 9 N95-10940

FLOW MEASUREMENT

Oscillating airfoil compressible dynamic stall studies
[HTN-94-00704] p 3 A95-60183

FLOW STABILITY

Instabilities originating from suction holes used for Laminar Flow Control (LFC)
[NASA-CR-196395] p 6 N95-10131

FLOW VISUALIZATION

Proceeding towards hypervelocities in ram accelerators
p 19 N95-10285

Control of wind tunnel operations using neural net interpretation of flow visualization records
[NASA-TM-106683] p 24 N95-10854

Flow-visualization study of the X-29A aircraft at high angles of attack using a 1/48-scale model
[NASA-TM-104268] p 8 N95-10858

Computer-aided light sheet flow visualization using photogrammetry
[NASA-TP-3416] p 26 N95-10859

FLUID DYNAMICS

Theories of turbulent combustion in high speed flows
[AD-A280933] p 23 N95-10535

Agglomeration multigrid for viscous turbulent flows
[NASA-CR-194953] p 8 N95-10848

FLUID FLOW

High performance parallel analysis of coupled problems for aircraft propulsion
[NASA-CR-195355] p 23 N95-10132

FLUTTER

The use of the Rieger number in the structural design with flutter constraints
[NASA-TM-109128] p 13 N95-11465

FLUTTER ANALYSIS

Flutter analysis of supersonic axial flow cascades using a high resolution Euler solver. Part 1: Formulation and validation
[NASA-TM-105798] p 23 N95-10244

FLY BY LIGHT CONTROL

Fly-By-Light/Power-By-Wire Requirements and Technology Workshop
[NASA-CR-10108] p 12 N95-10245

FLY BY WIRE CONTROL

Dryden and transonic research
[NASA-TM-104281] p 1 N95-10709

GAS TURBINES

GAS TURBINES

Modeling improvements and users manual for axial-flow turbine off-design computer code AXOD
[NASA-CR-195370] p 8 N95-10853

GENERAL AVIATION AIRCRAFT

General Aviation Task Force report
[NASA-TM-103950] p 1 N95-11463

GENERAL OVERVIEWS

Dryden overview for schools
[NASA-TM-104282] p 21 N95-10710
Dryden tour tape, 1994
[NASA-TM-104288] p 21 N95-10714

GEOGRAPHIC INFORMATION SYSTEMS

Integrating NOISEMAP with the Geographic Resource Analysis Support System (GRASS) to enhance environmental impact assessments and land use compatibility studies
p 31 N95-11311

GOERTLER INSTABILITY

Numerical study of Gortler instability: Application to the design of a quiet supersonic wind tunnel
[PB94-184801] p 21 N95-10844

GOVERNMENT/INDUSTRY RELATIONS

General Aviation Task Force report
[NASA-TM-103950] p 1 N95-11463

GRAPHICAL USER INTERFACE

Noise modeling for MOAs and ranges
p 32 N95-11322

GRAVITATIONAL EFFECTS

Validation of empirical orbit error corrections using crossover difference differences
[HTN-94-00912] p 25 A95-60227

GRAVITATIONAL FIELDS

Validation of empirical orbit error corrections using crossover difference differences
[HTN-94-00912] p 25 A95-60227

GRID GENERATION (MATHEMATICS)

Numerical simulation of the flow about the F-18 HARV at high angle of attack
[NASA-CR-196396] p 9 N95-10940

GROUND EFFECT (AERODYNAMICS)

Numerical simulation of powered-lift flows
[HTN-94-00700] p 3 A95-60179
Numerical simulation of a complete STOVL aircraft in ground effect
[AIAA PAPER 93-4880] p 4 A95-60187

3D visualization of unsteady 2D airplane wake vortices
[NASA-CR-194931] p 27 N95-11593

GROUND RESONANCE

Dynamic response of NASA Rotor Test Apparatus and Sikorsky S-76 hub mounted in the 80- by 120-Foot Wind Tunnel
[NASA-TM-108847] p 25 N95-11389

GROUND STATIONS

An application of virtual prototyping to the flight test and evaluation of an unmanned air vehicle
[AIAA-281749] p 14 N95-11595

GUST LOADS

Reanalysis of European flight loads data
[AIAA-282052] p 9 N95-11179

GUSTS

Reanalysis of European flight loads data
[AIAA-282052] p 9 N95-11179

H

HEAD-UP DISPLAYS

Instructional control and part/whole-task training: A review of the literature and an experimental comparison of strategies applied to instructional simulation
[AIAA-280860] p 21 N95-10919

HEATING EQUIPMENT

A programmable heater control circuit for spacecraft
[NASA-TM-108459] p 9 N95-11157

HELICOPTER CONTROL

Design and flight evaluation of an integrated navigation and near-terrain helicopter guidance system for night-time and adverse weather operations
[NASA-TM-108837] p 11 N95-10846

Research on an autonomous vision-guided helicopter
[AIAA PAPER 94-1240-CP] p 18 N95-11510

HELICOPTER DESIGN

Design and flight evaluation of an integrated navigation and near-terrain helicopter guidance system for night-time and adverse weather operations
[NASA-TM-108837] p 11 N95-10846

HELICOPTER PERFORMANCE

Validation of the dynamic response of a blade-element UH-60 simulation model in hovering flight
[HTN-94-00663] p 18 A95-60155

HELICOPTERS

Recent advances in Euler and Navier-Stokes methods for calculating helicopter rotor aerodynamics and acoustics
[HTN-94-00686] p 2 A95-60169

The present and future of aircraft noise models: A user's perspective
p 32 N95-11324

FAA vertical flight bibliography

[DOT/FAA/RD-94/17] p 14 N95-11684

FAA vertical flight bibliography

[DOT/FAA/RD-94/17] p 14 N95-11684

HELIUM

Numerical study of mixing in a high and low enthalpy supersonic test facility
p 7 N95-10467

HELMET MOUNTED DISPLAYS

Design and flight evaluation of an integrated navigation and near-terrain helicopter guidance system for night-time and adverse weather operations
[NASA-TM-108837] p 11 N95-10846

HIGH ALTITUDE BALLOONS

Scientific balloons
[NASA-TM-109907] p 7 N95-10556

HIGH REYNOLDS NUMBER

Numerical simulation of the flow about the F-18 HARV at high angle of attack
[NASA-CR-196396] p 9 N95-10940

HIGH SPEED

The High Speed Research Program
[NASA-TM-109869] p 10 N95-10548

HIGH TEMPERATURE

Brush seal performance and durability issues based on T-700 engine test results
[NASA-TM-106502] p 22 N95-11483

HILSCH TUBES

3D visualization of unsteady 2D airplane wake vortices
[NASA-CR-194931] p 27 N95-11593

HISTORIES

Langley overview
[NASA-TM-109891] p 20 N95-10547

HL-10 REENTRY VEHICLE

HL-10 dedication ceremony
[NASA-TM-104295] p 13 N95-10740

HOLOGRAPHY

Control of wind tunnel operations using neural net interpretation of flow visualization records
[NASA-TM-106883] p 24 N95-10854

HOVERING

Validation of the dynamic response of a blade-element UH-60 simulation model in hovering flight
[HTN-94-00663] p 18 A95-60155

Evaluation of simulation motion fidelity criteria in the vertical and directional axes
[HTN-94-00666] p 18 A95-60156

Navier-Stokes simulation of rotor-body flowfield in hover using overset grids
[PAPER C15] p 1 A95-60160

Study of noise on a small-scale hovering tilt rotor
[HTN-94-00712] p 5 A95-60190

Aerodynamic interactions between a rotor and wing in hover
[HTN-94-00714] p 5 A95-60192

HUBS

Dynamic response of NASA Rotor Test Apparatus and Sikorsky S-76 hub mounted in the 80- by 120-Foot Wind Tunnel
[NASA-TM-108847] p 25 N95-11389

HYBRID CIRCUITS

A programmable heater control circuit for spacecraft
[NASA-TM-108459] p 9 N95-11157

HYDROCARBON COMBUSTION

Hydrocarbon-fueled ramjet/scramjet technology program, phase 2 extension
[NASA-CR-189659] p 15 N95-10319

HYDROCARBON FUELS

Hydrocarbon-fueled ramjet/scramjet technology program, phase 2 extension
[NASA-CR-189659] p 15 N95-10319

HYPERSONIC FLIGHT

Design and evaluation of candidate pressure ports for the HYFLITE experiment
[NASA-TM-109146] p 22 N95-11003

HYPERSONIC FLOW

Computation of nonequilibrium viscous flows in arc-jet wind tunnel nozzles
[AIAA PAPER 94-0254] p 2 A95-60173

A comparison of three-dimensional nonequilibrium solution algorithms applied to hypersonic flows with stiff chemical source terms
[AIAA PAPER 93-2861] p 4 A95-60186

Development of an upwind, finite-volume code with finite-rate chemistry
[NASA-CR-196749] p 9 N95-11366

HYPERSONIC VEHICLES

Development of an upwind, finite-volume code with finite-rate chemistry
[NASA-CR-196749] p 9 N95-11366

HYPERSONICS

Application of scramjet engine technology to the design of ram accelerator projectiles
p 19 N95-10282

SUBJECT INDEX

HYPERVELOCITY GUNS

Proceeding towards accelerators

hypervelocities in ram
p 19 N95-10285

I

IGNITION

Programmed ignition of metal compounds in a scramjet
p 16 N95-10466

Theories of turbulent combustion in high speed flows
p 23 N95-10535

IMAGE PROCESSING

Computer-aided light sheet flow visualization using photogrammetry
[NASA-TP-3416] p 26 N95-10859

Research on an autonomous vision-guided helicopter
[AIAA PAPER 94-1240-CP] p 18 N95-11510

IMAGE RECONSTRUCTION

Computer-aided light sheet flow visualization using photogrammetry
[NASA-TP-3416] p 26 N95-10859

IMAGING TECHNIQUES

Micro-measurements of mechanical properties for adhesives and composites using digital imaging technology
[NASA-CR-196111] p 22 N95-10231

INCIDENCE

Oblique incidence sound absorption of porous materials covered by perforated metal and exposed to tangential airflow
[HTN-94-00681] p 19 A95-60165

INDUSTRIAL PLANTS

Noise Con 1994: Proceedings of the 1994 National Conference on Noise Control Engineering. Progress in Noise Control for Industry
[LC-75-24750] p 28 N95-11259

INFRARED IMAGERY

Numerical simulation of a complete STOVL aircraft in ground effect
[AIAA PAPER 93-4880] p 4 A95-60187

INLET FLOW

A full Navier-Stokes analysis of subsonic diffuser of a biurated 70/30 supersonic inlet for high speed civil transport application
[NASA-TM-106637] p 8 N95-10820

Numerical simulation of the flow about the F-18 HARV at high angle of attack
[NASA-CR-196396] p 9 N95-10940

Inlet flow test calibration for a small axial compressor facility. Part 1: Design and experimental results
[NASA-TM-106719] p 16 N95-11005

INSTRUMENT ERRORS

Effects of vibration on inertial wind-tunnel model attitude measurement devices
[NASA-TM-109083] p 21 N95-11466

INSULATION

25 years of airport sound insulation programs
p 31 N95-11307

INTEGRAL EQUATIONS

Steady and unsteady three-dimensional transonic flow computations by integral equation method
[NASA-CR-196777] p 10 N95-11582

INTEGRATED CIRCUITS

A programmable heater control circuit for spacecraft
[NASA-TM-108459] p 9 N95-11157

INTERACTIONAL AERODYNAMICS

Instabilities originating from suction holes used for Laminar Flow Control (LFC)
[NASA-CR-196395] p 6 N95-10131

INTERFEROMETERS

Interferometry and computational studies of an oscillating airfoil compressible dynamic stall flow field
[HTN-94-00703] p 3 A95-60182

INTERNATIONAL TRADE

General Aviation Task Force report
[NASA-TM-109950] p 1 N95-11463

INVISCID FLOW

Computations of unsteady aerodynamic loads around oscillating wings. Part 1: Formulation
[PB94-180049] p 7 N95-10136

Computations of unsteady aerodynamic loads around oscillating wings. Part 2: Computed results and discussions
[PB94-180056] p 7 N95-10137

J

JET AIRCRAFT NOISE

On the scaling of small-scale jet noise to large scale
[AIAA PAPER 92-02109] p 27 A95-60166

Near field noise prediction requirements
[ISVR-TR-234] p 27 N95-11166

Fan noise research at NASA
p 28 N95-11260

- Exact dynamic responses of periodic multi-span beams under convected pressure fields** p 25 N95-11288
- JET ENGINE FUELS**
Hydrocarbon-fueled ramjet/scramjet technology program, phase 2 extension p 15 N95-10319
[NASA-CR-189659]
Programmed ignition of metal compounds in a scramjet p 16 N95-10466
- JET ENGINES**
Radiant energy measurements from a scaled jet engine axisymmetric exhaust nozzle for a baseline code validation case [NASA-TM-106686] p 25 N95-11409
- JET FLOW**
Jet to freestream velocity ratio computations for a jet in a crossflow [AIAA PAPER 93-4860] p 2 A95-60178
Numerical simulation of powered-lift flows p 3 A95-60179
[HTN-94-00700]
- JET LIFT**
Numerical simulation of powered-lift flows [HTN-94-00700] p 3 A95-60179
- JET MIXING FLOW**
On the scaling of small-scale jet noise to large scale [AIAA PAPER 92-02109] p 27 A95-60166
Experimental and analytical investigations of wave enhanced supersonic combustors [AIAA PAPER 89-2787] p 14 A95-60172
Numerical study of mixing in a high and low enthalpy supersonic test facility p 7 N95-10467
Near field noise prediction requirements p 27 N95-11166
[ISVR-TR-234]
- K**
- KALMAN FILTERS**
Flight test development and evaluation of a Kalman filter state estimator for low-altitude flight [HTN-94-00684] p 16 A95-60167
- L**
- LABORATORY EQUIPMENT**
NASA Lewis Propulsion Systems Laboratory test article systems criteria [NASA-TM-106589] p 20 N95-10446
- LAMINAR BOUNDARY LAYER**
Instabilities originating from suction holes used for Laminar Flow Control (LFC) [NASA-CR-196395] p 6 N95-10131
- LAMINAR FLOW**
Transonic light test of a laminar flow leading edge with surface excrescences [NASA-TM-4597] p 9 N95-11158
- LAND**
Assessing effects of military aircraft noise on residential property values near airbases p 31 N95-11310
- LAND USE**
Integrating NOISEMAP with the Geographic Resource Analysis Support System (GRASS) to enhance environmental impact assessments and land use compatibility studies p 31 N95-11311
- LANDING SIMULATION**
Evaluation of F-18A approach and landing flying qualities using an in-flight simulator [CALSPAN-6241-F-1] p 12 N95-10442
- LASER DOPPLER VELOCIMETERS**
LDV measurements in dynamically separated flows p 5 A95-60191
[ISBN 0-8194-1311-9]
- LEADING EDGE FLAPS**
Effect of leading- and trailing-edge flaps on clipped delta wings with and without wing camber at supersonic speeds [NASA-TM-4542] p 5 N95-10028
Numerical simulation of the flow about the F-18 HARV at high angle of attack [NASA-CR-196396] p 9 N95-10940
- LEADING EDGES**
Transonic light test of a laminar flow leading edge with surface excrescences [NASA-TM-4597] p 9 N95-11158
- LIFE (DURABILITY)**
Micro-measurements of mechanical properties for adhesives and composites using digital imaging technology [NASA-CR-196111] p 22 N95-10231
- LIFT**
Navier-Stokes simulations of WECS airfoil flowfields [DE94-013341] p 7 N95-10226
- LIFTING BODIES**
HL-10 dedication ceremony p 13 N95-10740
[NASA-TM-104295]

- LININGS**
Oblique incidence sound absorption of porous materials covered by perforated metal and exposed to tangential airflow [HTN-94-00681] p 19 A95-60165
- LIQUID-VAPOR INTERFACES**
Flow-visualization study of the X-29A aircraft at high angles of attack using a 1/48-scale model [NASA-TM-104268] p 8 N95-10858
- LONGITUDINAL CONTROL**
High-Alpha Research Vehicle (HARV) longitudinal controller. Design, analyses, and simulation results [NASA-TP-3446] p 17 N95-10860
- LOUDSPEAKERS**
Broadband, wide-area active control of sound radiated from vibrating structures using local surface-mounted radiation suppression devices p 30 N95-11283
- LOW ALTITUDE**
Flight test development and evaluation of a Kalman filter state estimator for low-altitude flight [HTN-94-00684] p 16 A95-60167
- LOW ALTITUDE**
Simulation development of a forward sensor-enhanced low-altitude guidance system [HTN-94-00688] p 17 A95-60170
- LOW ALTITUDE**
Design and flight evaluation of an integrated navigation and near-terrain helicopter guidance system for night-time and adverse weather operations p 11 N95-10846
- LOW FREQUENCIES**
Low frequency ultrasonic nondestructive inspection of aluminum/adhesive fuselage lap splices [DE94-014242] p 24 N95-11135

M

- MACH NUMBER**
Oscillating airfoil compressible dynamic stall studies [HTN-94-00704] p 3 A95-60183
A comparison of three-dimensional nonequilibrium solution algorithms applied to hypersonic flows with stiff chemical source terms [AIAA PAPER 93-2861] p 4 A95-60186
A study of compressibility effects on dynamic stall of rapidly pitching airfoils [HTN-94-00715] p 5 A95-60193
- Effect of leading- and trailing-edge flaps on clipped delta wings with and without wing camber at supersonic speeds** [NASA-TM-4542] p 5 N95-10028
- MANUALS**
NASA Lewis Propulsion Systems Laboratory customer guide manual [NASA-TM-106569] p 21 N95-10822
- MAP MATCHING GUIDANCE**
Simulation development of a forward sensor-enhanced low-altitude guidance system [HTN-94-00688] p 17 A95-60170
- MASS FLOW**
A full Navier-Stokes analysis of subsonic diffuser of a bifurcated 70/30 supersonic inlet for high speed civil transport application [NASA-TM-106637] p 8 N95-10820
- MASSIVELY PARALLEL PROCESSORS**
Steady and unsteady three-dimensional transonic flow computations by integral equation method [NASA-CR-196777] p 10 N95-11582
- MATHEMATICAL MODELS**
High performance parallel analysis of coupled problems for aircraft propulsion [NASA-CR-195355] p 23 N95-10132
Modeling improvements and users manual for axial-flow turbine off-design computer code AXOD [NASA-CR-195370] p 8 N95-10853
- Plastic hinge modeling of structures** [NIAH-94-14] p 24 N95-11168
- Empirical refinements to boundary layer transition noise models** p 28 N95-11262
- Integrating NOISEMAP with the Geographic Resource Analysis Support System (GRASS) to enhance environmental impact assessments and land use compatibility studies** p 31 N95-11311
- INM contour validation: A case study** p 31 N95-11321

MATRIX MATERIALS

- Novel matrix resins for composites for aircraft primary structures, phase 1 [NASA-CR-189657] p 23 N95-10318

MECHANICAL PROPERTIES

- Micro-measurements of mechanical properties for adhesives and composites using digital imaging technology [NASA-CR-196111] p 22 N95-10231

METEOROLOGICAL RADAR

- Vertical wind estimation from horizontal wind measurements p 26 N95-10567

METEOROLOGICAL SERVICES

- Future enhancements to ground-based microburst detection p 11 N95-10570

METHOD OF MOMENTS

- A users manual for the method of moments Aircraft Modeling Code (AMC), version 2 [NASA-CR-196445] p 24 N95-11252

MICROBURSTS (METEOROLOGY)

- Arborne Windshear Detection and Warning Systems. Fifth and Final Combined Manufacturers' and Technologists' Conference, part 1 [NASA-CP-10139-PT-1] p 10 N95-10566
- Vertical wind estimation from horizontal wind measurements p 26 N95-10567
- Characteristics of a dry, pulsating microburst at Denver Stapleton Airport p 26 N95-10568
- Future enhancements to ground-based microburst detection p 11 N95-10570
- Determining F-factor using ground-based Doppler radar. Validation and results p 11 N95-10571

MICROCOMPUTERS

- Instructional control and part/whole-task training: A review of the literature and an experimental comparison of strategies applied to instructional simulation [AD-A280860] p 21 N95-10919

MICROPHONES

- Aeroacoustic probe design for microphone to reduce flow-induced self-noise [AIAA PAPER 93-4343] p 19 A95-60163
- Oblique incidence sound absorption of porous materials covered by perforated metal and exposed to tangential airflow [HTN-94-00681] p 19 A95-60165

MILITARY AIR FACILITIES

- Assessing effects of military aircraft noise on residential property values near airbases p 31 N95-11310

MILITARY HELICOPTERS

- Design and flight evaluation of an integrated navigation and near-terrain helicopter guidance system for night-time and adverse weather operations [NASA-TM-108837] p 11 N95-10846

MILITARY OPERATIONS

- Design and flight evaluation of an integrated navigation and near-terrain helicopter guidance system for night-time and adverse weather operations [NASA-TM-108837] p 11 N95-10846
- MOAMAP: A model that combines several different kinds of aircraft operations p 32 N95-11323
- The present and future of aircraft noise models: A user's perspective p 32 N95-11324

MINIATURE ELECTRONIC EQUIPMENT

- A programmable heater control circuit for spacecraft [NASA-TM-108459] p 9 N95-11157

MODAL RESPONSE

- Dynamic response of NASA Rotor Test Apparatus and Sikorsky S-76 hub mounted in the 80- by 120-Foot Wind Tunnel [NASA-TM-108847] p 25 N95-11389

MODULES

- Advanced composites structural concepts and materials technologies for primary aircraft structures: Structural response and failure analysis [NASA-CR-4448] p 11 N95-10240

MOTION SIMULATION

- Evaluation of simulation motion fidelity criteria in the vertical and directional axes [HTN-94-00666] p 18 A95-60156

MOUNTING

- A theoretical analysis of airborne sound transfer for a resiliently mounted machine to its foundation p 30 N95-11304

MULTIGRID METHODS

- Navier-Stokes simulation of rotor-body flowfield in hover using overset grids [PAPER C15] p 1 A95-60160
- Jet to freestream velocity ratio computations for a jet in a crossflow [AIAA PAPER 93-4860] p 2 A95-60178
- Agglomeration multigrid for viscous turbulent flows [NASA-CR-194953] p 8 N95-10848

MULTIPATH TRANSMISSION

- Active control of complex noise problems using a broadband, multichannel controller p 29 N95-11271

MULTIPHASE FLOW

- An aerodynamic analysis of a mixed flow turbine [NASA-TM-106674] p 15 N95-10153

N

NASA PROGRAMS

- NASA Lewis Propulsion Systems Laboratory test article systems criteria [NASA-TM-106589] p 20 N95-10446
- Langley overview [NASA-TM-109891] p 20 N95-10547

NATIONAL AEROSPACE PLANE PROGRAM

Dryden overview for schools p 21 N95-10710
[NASA-TM-104282]
Dryden tour tape, 1994 p 21 N95-10714
[NASA-TM-104288]
Building the Integrated Test Facility: A foundation for the future p 21 N95-10738
[NASA-TM-104280]
NASA Lewis Propulsion Systems Laboratory customer guide manual p 21 N95-10822
[NASA-TM-106569]
General Aviation Task Force report p 1 N95-11463
[NASA-TM-109950]
NATIONAL AEROSPACE PLANE PROGRAM
Aero-Space Plane: Flexible access to space p 22 N95-10553
[NASA-TM-109904]
NAVER-STOKES EQUATION
Naver-Stokes simulation of rotor-body flowfield in hover using overset grids p 1 A95-60160
[PAPER C15]
Recent advances in Euler and Naver-Stokes methods for calculating helicopter rotor aerodynamics and acoustics p 2 A95-60169
[HTN-94-00686]
Naver-Stokes simulations of WECS airfoil flowfields p 7 N95-10226
[DE94-013341]
A full Naver-Stokes analysis of subsonic diffuser of a bifurcated 70/30 supersonic inlet for high speed civil transport application p 8 N95-10820
[NASA-TM-106637]
Agglomeration, multigrid for viscous turbulent flows p 8 N95-10848
[NASA-CR-194953]
Numerical simulation of the flow about the F-18 HARV at high angle of attack p 9 N95-10940
[NASA-CR-196396]
Steady and unsteady three-dimensional transonic flow computations by integral equation method p 10 N95-11582
[NASA-CR-196777]
NAVIGATION AIDS
Flight test development and evaluation of a Kalman filter state estimator for low-altitude flight p 16 A95-60167
[HTN-94-00684]
NAVIGATION INSTRUMENTS
Simulation development of a forward sensor-enhanced low-altitude guidance system p 17 A95-60170
[HTN-94-00688]
NEAR FIELDS
Near field noise prediction requirements p 27 N95-11166
[ISVR-TR-234]
NEURAL NETS
Control of wind tunnel operations using neural net interpretation of flow visualization records p 24 N95-10854
[NASA-TM-106683]
NOISE (SOUND)
Noise Con 1994: Proceedings of the 1994 National Conference on Noise Control Engineering. Progress in Noise Control for Industry p 28 N95-11259
[ILC-75-24750]
Comments on the use of structureborne noise analysis for large commercial airplanes p 30 N95-11287
25 years of airport sound insulation programs p 31 N95-11307
At Istanbul-Ataturk Airport measurement and analysis of noise in due of take-off time p 31 N95-11319
Fan noise research at NASA p 28 N95-11260
Active control of complex noise problems using a broadband, multichannel controller p 29 N95-11271
NOISE GENERATORS
Empirical refinements to boundary layer transition noise models p 28 N95-11262
Integrating NOISEMAP with the Geographic Resource Analysis Support System (GRASS) to enhance environmental impact assessments and land use compatibility studies p 31 N95-11311
Noise modeling for MOAs and ranges p 32 N95-11322
[ISVR-TR-234]
NOISE MEASUREMENT
Near field noise prediction requirements p 27 N95-11166
25 years of airport sound insulation programs p 31 N95-11307
At Istanbul-Ataturk Airport measurement and analysis of noise in due of take-off time p 31 N95-11319
INM contour validation: A case study p 31 N95-11321
NOISE POLLUTION
Noise Con 1994: Proceedings of the 1994 National Conference on Noise Control Engineering. Progress in Noise Control for Industry p 28 N95-11259
[ILC-75-24750]
Fan noise research at NASA p 28 N95-11260
Transmission loss characteristics of aircraft sidewall systems to control cabin interior noise p 28 N95-11261
25 years of airport sound insulation programs p 31 N95-11307

SUBJECT INDEX

Integrating NOISEMAP with the Geographic Resource Analysis Support System (GRASS) to enhance environmental impact assessments and land use compatibility studies p 31 N95-11311
Determining the effects of alternative departure cutock altitudes and power settings: A case study, John Wayne Airport p 31 N95-11320
NOISE PREDICTION
Comments on the use of structureborne noise analysis for large commercial airplanes p 30 N95-11287
A theoretical analysis of airborne sound transfer for a resiliently mounted machine to its foundation p 30 N95-11304
MOAMAP: A model that combines several different kinds of aircraft operations p 32 N95-11323
NOISE PREDICTION (AIRCRAFT)
Near field noise prediction requirements p 27 N95-11166
[ISVR-TR-234]
INM contour validation: A case study p 31 N95-11321
Noise modeling for MOAs and ranges p 32 N95-11322
The present and future of aircraft noise models: A user's perspective p 32 N95-11324
NOISE REDUCTION
Aeroacoustic probe design for microphone to reduce flow-induced self-noise p 19 A95-60163
[AIAA PAPER 93-4343]
Oblique incidence sound absorption of porous materials covered by perforated metal and exposed to tangential airflow p 19 A95-60165
[HTN-94-00681]
Control of wind tunnel operations using neural net interpretation of flow visualization records p 24 N95-10854
[NASA-TM-106683]
Noise Con 1994: Proceedings of the 1994 National Conference on Noise Control Engineering. Progress in Noise Control for Industry p 28 N95-11259
[ILC-75-24750]
Fan noise research at NASA p 28 N95-11260
Transmission loss characteristics of aircraft sidewall systems to control cabin interior noise p 28 N95-11261
Achievements and tasks for active noise control p 29 N95-11270
Active control of complex noise problems using a broadband, multichannel controller p 29 N95-11271
Active control of turbomachine discrete tones p 29 N95-11275
Active control of interior noise in a business jet using piezoceramic actuators p 29 N95-11276
Analytical investigation of adaptive control of radiated inlet noise from turbulent engines p 30 N95-11277
Adaptive tuned vibration absorbers: Tuning laws, tracking agility, sizing, and physical implementations p 25 N95-11280
Broadband, wide-area active control of sound radiated from vibrating structures using local surface-mounted radiation suppression devices p 30 N95-11283
Comments on the use of structureborne noise analysis for large commercial airplanes p 30 N95-11287
A theoretical analysis of airborne sound transfer for a resiliently mounted machine to its foundation p 30 N95-11304
Effect of constraining layer stiffness on performance of damping tile materials using finite element modelling with Rayleigh integral p 25 years of airport sound insulation programs p 31 N95-11307
Integrating NOISEMAP with the Geographic Resource Analysis Support System (GRASS) to enhance environmental impact assessments and land use compatibility studies p 31 N95-11311
Determining the effects of alternative departure cutock altitudes and power settings: A case study, John Wayne Airport p 31 N95-11320
Noise modeling for MOAs and ranges p 32 N95-11322
NOISE SPECTRA
Active control of complex noise problems using a broadband, multichannel controller p 29 N95-11271
NONEQUILIBRIUM FLOW
Computation of nonequilibrium viscous flows in arc-jet wind tunnel nozzles p 2 A95-60173
[AIAA PAPER 94-0254]
A comparison of three-dimensional nonequilibrium solution algorithms applied to hypersonic flows with stiff chemical source terms p 4 A95-60186
[AIAA PAPER 93-2861]
NONINTRUSIVE MEASUREMENT
Flame-spreading phenomena in the fin-slot region of a solid rocket motor p 23 N95-10296
NONLINEAR SYSTEMS
High-Alpha Research Vehicle (HARV) longitudinal controller: Design, analyses, and simulation results p 17 N95-10860
[NASA-TP-3446]
NONUNIFORMITY
Flame-spreading phenomena in the fin-slot region of a solid rocket motor p 23 N95-10296
NORMAL SHOCK WAVES
Visualization of one-dimensional flow processes in a dual-mode scramjet engine p 15 N95-10465
NOZZLE FLOW
On the scaling of small-scale jet noise to large scale [AIAA PAPER 92-02109] p 27 A95-60166
Computation of nonequilibrium viscous flows in arc-jet wind tunnel nozzles p 2 A95-60173
[AIAA PAPER 94-0254]
Propulsion research concerning SFRJ-motors [PB94-179520] p 14 N95-10083
Two-dimensional converging-diverging rippled nozzles at transonic speeds --- performed in the Langley 16-Foot Transonic Tunnel p 6 N95-10129
NOZZLE GEOMETRY
Two-dimensional converging-diverging rippled nozzles at transonic speeds --- performed in the Langley 16-Foot Transonic Tunnel p 6 N95-10129
[NASA-TP-3440]
Radiant energy measurements from a scaled jet engine axisymmetric exhaust nozzle for a baseline code validation case [NASA-TM-106686] p 25 N95-11409
NUMERICAL ANALYSIS
Numerical simulation of the flow about the F-18 HARV at high angle of attack [NASA-CR-196396] p 9 N95-10940
NUMERICAL CONTROL
Design and flight evaluation of an integrated navigation and near-terrain helicopter guidance system for night-time and adverse weather operations p 11 N95-10846
[NASA-TM-108837]
Formal design and verification of a reliable computing platform for real-time control (phase 3 results) p 33 N95-10873
[NASA-TM-109140]
Low frequency ultrasonic nondestructive inspection of aluminum/adhesive fuselage lap splices [IDE94-014242] p 24 N95-11135
NUMERICAL FLOW VISUALIZATION
Visualization of one-dimensional flow processes in a dual-mode scramjet engine p 15 N95-10465
3D visualization of unsteady 2D airplane wake vortices [NASA-CR-194931] p 27 N95-11593
O
OBLIQUE SHOCK WAVES
Visualization of one-dimensional flow processes in a dual-mode scramjet engine p 15 N95-10465
OCEAN DATA ACQUISITIONS SYSTEMS
Validation of empirical orbit error corrections using crossover difference differences p 25 A95-60227
[HTN-94-00912]
OCEANOGRAPHY
Validation of empirical orbit error corrections using crossover difference differences p 25 A95-60227
[HTN-94-00912]
ONBOARD DATA PROCESSING
Design and flight evaluation of an integrated navigation and near-terrain helicopter guidance system for night-time and adverse weather operations p 11 N95-10846
[NASA-TM-108837]
ONE DIMENSIONAL FLOW
Visualization of one-dimensional flow processes in a dual-mode scramjet engine p 15 N95-10465
OPERATIONS RESEARCH
NASA Lewis Propulsion Systems Laboratory test article systems criteria [NASA-TM-106589] p 20 N95-10446
OPTIMAL CONTROL
Extended cooperative control synthesis p 17 N95-10220
[NASA-TM-4561]
On the use of controls for subsonic transport performance improvement: Overview and future directions p 10 N95-11408
OPTIMIZATION
The use of the Regier number in the structural design with flutter constraints [NASA-TM-109128] p 13 N95-11465
OSCILLATING FLOW
Computations of unsteady aerodynamic loads around oscillating wings. Part 1: Formulation [PB94-180049] p 7 N95-10136
Computations of unsteady aerodynamic loads around oscillating wings. Part 2: Computed results and discussions [PB94-180056] p 7 N95-10137

OVER-THE-HORIZON RADAR

An application of virtual prototyping to the flight test and evaluation of an unmanned air vehicle p 14 N95-11595 [AD-A281749]

OZONE

Three dimensional model calculations of the global dispersion of high speed aircraft exhaust and implications for stratospheric ozone loss p 26 N95-10657

OZONE DEPLETION

Three dimensional model calculations of the global dispersion of high speed aircraft exhaust and implications for stratospheric ozone loss p 26 N95-10657

P**PANEL METHOD (FLUID DYNAMICS)**

Steady and unsteady three-dimensional transonic flow computations by integral equation method [NASA-CR-196771] p 10 N95-11582

PARALLEL PROCESSING (COMPUTERS)

High performance parallel analysis of coupled problems for aircraft propulsion p 23 N95-10132 [NASA-CR-195355]

Control of wind tunnel operations using neural net interpretation of flow visualization records [NASA-TM-106683] p 24 N95-10854

PASSENGER AIRCRAFT

Low frequency ultrasonic nondestructive inspection of aluminum/adhesive fuselage lap splices [DE94-014242] p 24 N95-11135

PERFORMANCE PREDICTION

Modeling improvements and users manual for axial-flow turbine off-design computer code AXOD [NASA-CR-195370] p 8 N95-10853

PERFORMANCE TESTS

NASA Lewis Propulsion Systems Laboratory test article systems criteria [NASA-TM-106589] p 20 N95-10446

Brush seal performance and durability issues based on T-700 engine test results [NASA-TM-106502] p 22 N95-11483

PERMEABILITY

Analysis of flow channeling near the wall in packed beds [HTN-94-00698] p 2 A95-60177

PHOTOGRAMMETRY

Computer-aided light sheet flow visualization using photogrammetry [NASA-TP-3416] p 26 N95-10859

PIEZOELECTRIC CERAMICS

Active control of interior noise in a business jet using piezoceramic actuators p 29 N95-11276

PILOT TRAINING

Evaluation of simulation motion fidelity criteria in the vertical and directional axes [HTN-94-00666] p 18 A95-60156

PISTONS

High performance parallel analysis of coupled problems for aircraft propulsion p 23 N95-10132 [NASA-CR-195355]

PITCH (INCLINATION)

A study of compressibility effects on dynamic stall of rapidly pitching airfoils [HTN-94-00715] p 5 A95-60193

PLASMA JET WIND TUNNELS

Computation of nonequilibrium viscous flows in arc-jet wind tunnel nozzles [AIAA PAPER 94-0254] p 2 A95-60173

PLASTIC DEFORMATION

Plastic hinge modeling of structures [NAR-94-14] p 24 N95-11168

POISSON EQUATION

Steady and unsteady three-dimensional transonic flow computations by integral equation method [NASA-CR-196771] p 10 N95-11582

POLLUTION CONTROL

Noise Con 1994: Proceedings of the 1994 National Conference on Noise Control Engineering, Progress in Noise Control for Industry [LC-75-24750] p 28 N95-11259

Fan noise research at NASA Transmission loss characteristics of aircraft sidewall systems to control cabin interior noise p 28 N95-11261

POLLUTION TRANSPORT

Three dimensional model calculations of the global dispersion of high speed aircraft exhaust and implications for stratospheric ozone loss p 26 N95-10657

POLYMER MATRIX COMPOSITES

Micro-measurements of mechanical properties for adhesives and composites using digital imaging technology [NASA-CR-196111] p 22 N95-10231

POROUS BOUNDARY LAYER CONTROL

Instabilities originating from suction holes used for Laminar Flow Control (LFC) p 6 N95-10131 [NASA-CR-196395]

POROUS MATERIALS

Oblique incidence sound absorption of porous materials covered by perforated metal and exposed to tangential airflow [HTN-94-00681] p 19 A95-60165

Analysis of flow channeling near the wall in packed beds [HTN-94-00698] p 2 A95-60177

PORTS (OPENINGS)

Design and evaluation of candidate pressure ports for the HYFLITE experiment p 22 N95-11003 [NASA-TM-109146]

POWER EFFICIENCY

Determining the effects of alternative departure cutback altitudes and power settings: A case study, John Wayne Airport p 31 N95-11320

POWER TRANSMISSION

A theoretical analysis of airborne sound transfer for a resiliently mounted machine to its foundation p 30 N95-11304

PREDICTION ANALYSIS TECHNIQUES

Micro-measurements of mechanical properties for adhesives and composites using digital imaging technology [NASA-CR-196111] p 22 N95-10231

A theoretical analysis of airborne sound transfer for a resiliently mounted machine to its foundation p 30 N95-11304

PREPREGS

Novel matrix resins for composites for aircraft primary structures, phase 1 [NASA-CR-196657] p 23 N95-10318

PRESSURE DISTRIBUTION

Effect of passive venting on static pressure distributions in cavities at subsonic and transonic speeds [NASA-TM-4549] p 6 N95-10029

Navier-Stokes simulations of WECS airfoil flowfields [DE94-013341] p 7 N95-10226

Effect of weak periodic pressure gradient on streamwise vortices near a wall p 29 N95-11263

Exact dynamic responses of periodic multi-span beams under convected pressure fields p 25 N95-11288

PRESSURE EFFECTS

Effect of weak periodic pressure gradient on streamwise vortices near a wall p 29 N95-11263

PRESSURE GRADIENTS

Effect of weak periodic pressure gradient on streamwise vortices near a wall p 29 N95-11263

PRESSURE MEASUREMENT

Design and evaluation of candidate pressure ports for the HYFLITE experiment [NASA-TM-109146] p 22 N95-11003

PRESSURE OSCILLATIONS

Effect of weak periodic pressure gradient on streamwise vortices near a wall p 29 N95-11263

PRESSURE SENSORS

Design and evaluation of candidate pressure ports for the HYFLITE experiment [NASA-TM-109146] p 22 N95-11003

PROBABILITY DENSITY FUNCTIONS

MOAMAP: A model that combines several different kinds of aircraft operations p 32 N95-11323

PRODUCT DEVELOPMENT

FAA vertical flight bibliography [DOT/FAA/RD-94/17] p 14 N95-11684

PRODUCTIVITY

Potential impacts of advanced aerodynamic technology on air transportation system productivity [NASA-TM-109154] p 10 N95-11489

PROGRAM VERIFICATION (COMPUTERS)

Dryden lectureship in research, a perspective on CFD validation [AIAA PAPER 93-0002] p 3 A95-60180

Formal design and verification of a reliable computing platform for real-time control (phase 3 results) [NASA-TM-109140] p 33 N95-10873

PROJECTILES

Propulsion research concerning SFRJ-motors [PB94-179520] p 14 N95-10083

PROPPELLANT COMBUSTION

Application of scramjet engine technology to the design of ram accelerator projectiles p 19 N95-10282

PROPULSION SYSTEM CONFIGURATIONS

NASA Lewis Propulsion Systems Laboratory test article systems criteria [NASA-TM-106589] p 20 N95-10446

NASA Lewis Propulsion Systems Laboratory customer guide manual [NASA-TM-106569] p 21 N95-10822

PROPULSION SYSTEM PERFORMANCE

Computational fluid dynamics study of the variable-pitch split-blade fan concept p 15 N95-10247 [NASA-CR-189206]

NASA Lewis Propulsion Systems Laboratory test article systems criteria p 20 N95-10446 [NASA-TM-106589]

NASA Lewis Propulsion Systems Laboratory customer guide manual [NASA-TM-106569] p 21 N95-10822

Modeling improvements and users manual for axial-flow turbine off-design computer code AXOD [NASA-CR-195370] p 8 N95-10853

PROTOTYPES

Low frequency ultrasonic nondestructive inspection of aluminum/adhesive fuselage lap splices [DE94-014242] p 24 N95-11135

An application of virtual prototyping to the flight test and evaluation of an unmanned air vehicle [AD-A281749] p 14 N95-11595

PROVING

Validation of empirical orbit error corrections using crossover difference differences [HTN-94-00912] p 25 A95-60227

PYROLYSIS

Propulsion research concerning SFRJ-motors [PB94-179520] p 14 N95-10083

R**RADAR DETECTION**

Airborne Windshear Detection and Warning Systems, Fifth and Final Combined Manufacturers' and Technologists' Conference, part 1 [NASA-CP-10139-PT-1] p 10 N95-10566

Vertical wind estimation from horizontal wind measurements p 26 N95-10567

Future enhancements to ground-based microburst detection p 11 N95-10570

Determining F-factor using ground-based Doppler radar: Validation and results p 11 N95-10571

RADIATION MEASUREMENT

Radiant energy measurements from a scaled jet engine axisymmetric exhaust nozzle for a baseline code validation case [NASA-TM-106686] p 25 N95-11409

RADIO CONTROL

Radio controlled for research [NASA-TM-104292] p 17 N95-10717

RADIO FREQUENCIES

Low frequency ultrasonic nondestructive inspection of aluminum/adhesive fuselage lap splices [DE94-014242] p 24 N95-11135

RAM ACCELERATORS

Application of scramjet engine technology to the design of ram accelerator projectiles p 19 N95-10282

Eglin Air Force Base Ram Accelerator Research Facility p 19 N95-10284

Proceeding towards hypervelocities in ram accelerators p 19 N95-10285

RAMJET ENGINES

Hydrocarbon-fueled ramjet/scramjet technology program, phase 2 extension [NASA-CR-189659] p 15 N95-10319

REACTING FLOW

Theories of turbulent combustion in high speed flows [AD-A280933] p 23 N95-10535

Development of an upwind, finite-volume code with finite-rate chemistry [NASA-CR-196749] p 9 N95-11366

REAL TIME OPERATION

Formal design and verification of a reliable computing platform for real-time control (phase 3 results) [NASA-TM-109140] p 33 N95-10873

The 4-D approach to visual control of autonomous systems [AIAA PAPER 94-1243-CP] p 27 N95-11513

RECTANGULAR WINGS

Steady and unsteady three-dimensional transonic flow computations by integral equation method [NASA-CR-196771] p 10 N95-11582

RELAXATION METHOD (MATHEMATICS)

A comparison of three-dimensional nonequilibrium solution algorithms applied to hypersonic flows with stiff chemical source terms [AIAA PAPER 93-2861] p 4 A95-60186

REMOVED PILOTED VEHICLES

An application of virtual prototyping to the flight test and evaluation of an unmanned air vehicle [AD-A281749] p 14 N95-11595

RESEARCH

Dryden and transonic research [NASA-TM-104281] p 1 N95-10709

RESEARCH AIRCRAFT

RESEARCH AIRCRAFT

F-18 HARV presentation for industry p 13 N95-10711
[NASA-TM-104283]
Research excitation system flight testing p 13 N95-10715
[NASA-TM-104289]
Radio controlled for research p 17 N95-10717
[NASA-TM-104292]
F-104 resource tape p 13 N95-10741
[NASA-TM-104296]
F-15 B35 (HIDEC) resource tape p 13 N95-10742
[NASA-TM-104297]
F-16XL resource tape p 13 N95-10743
[NASA-TM-104298]
X-31 resource tape p 13 N95-10745
[NASA-TM-104300]
NACA/NASA: X-1 through X-31 p 1 N95-10749
[NASA-TM-104304]
Fan noise research at NASA p 28 N95-11260
[NASA-TM-104305]

RESEARCH AND DEVELOPMENT

Dryden summer 1994 update p 33 N95-10750
[NASA-TM-104305]
JPSS report: Science and technology. Central Eurasia: Engineering and equipment. Gas dynamics of supersonic shortened nozzles p 22 N95-10931
[JPSS-UST-94-003-L]

RESEARCH FACILITIES

Eglin Air Force Base Ram Accelerator Research Facility p 19 N95-10284
[NASA-TM-104305]
Langley overview p 20 N95-10547
[NASA-TM-1039891]
Dryden overview for schools p 21 N95-10710
[NASA-TM-104282]
Dryden tour tape, 1994 p 21 N95-10714
[NASA-TM-104288]
Dryden overview for schools p 21 N95-10747
[NASA-TM-104302]
RESEARCH PROJECTS
NACA/NASA: X-1 through X-31 p 1 N95-10749
[NASA-TM-104304]
Dryden summer 1994 update p 33 N95-10750
[NASA-TM-104305]

RESEARCH VEHICLES

F-18 high alpha research vehicle resource tape p 13 N95-10744
[NASA-TM-104299]
High-Alpha Research Vehicle (HARV) longitudinal controller: Design, analyses, and simulation results p 17 N95-10860
[NASA-TP-3446]

RESIN MATRIX COMPOSITES

Novel matrix resins for composites for aircraft primary structures, phase 1 p 23 N95-10318
[NASA-CR-189657]

RESONANT FREQUENCIES

Dynamic response of NASA Rotor Test Apparatus and Sikorsky S-76 hub mounted in the 80- by 120-Foot Wind Tunnel p 25 N95-11389
[NASA-TM-108847]

RESONANT VIBRATION

A theoretical analysis of airborne sound transfer for a resiliently mounted machine to its foundation p 30 N95-11304
[NASA-TM-108847]

REYNOLDS EQUATION

Agglomeration, multigrad for viscous turbulent flows p 8 N95-10848
[NASA-CR-194853]

REYNOLDS NUMBER

An experimental investigation of wing tip turbulence with applications to aerodynamic p 1 A95-60164
[AIAA PAPER 86-1918]

Accuracy enhancements for overset grids using a defect correction approach p 3 A95-60181
[AIAA PAPER 94-0523]
A comparison of turbulence models in computing multi-element airfoil flows p 4 A95-60185
[AIAA PAPER 94-0291]
Effect of leading- and trailing-edge flaps on clipped delta wings with and without wing camber at supersonic speeds p 5 N95-10028
[NASA-TM-4542]

RIGID STRUCTURES

Plastic hinge modeling of structures p 24 N95-11168
[NIAR-94-14]

ROBOTICS

A generic telerobotics architecture for C-5 industrial processes p 27 N95-11529
[AIAA PAPER 94-1264-CP]

ROLLING MOMENTS

3D visualization of unsteady 2D airplane wake vortices p 27 N95-11593
[NASA-CR-194931]

ROTARY WING AIRCRAFT

Advanced distributed simulation technology advanced rotary wing aircraft. Strawnman verification and validation plan for the ARWA simulator system p 19 N95-10349
[AD-A280237]
Advanced distributed simulation technology advanced rotary wing aircraft. System/segment specification. Volume 1: Simulation system module p 20 N95-10350
[AD-A280238]

SUBJECT INDEX

SCALING LAWS

On the scaling of small-scale jet noise to large scale Volume 3. N95-102109 p 27 A95-60166
[AIAA PAPER 92-02109]

SCHLIEREN PHOTOGRAPHY

A study of compressibility effects on dynamic stall of rapidly pitching airfoils p 5 A95-60193
[HTN-94-00715]

SEPARATED FLOW

LDV measurements in dynamically separated flows ISBN 0-8194-1311-9 p 5 A95-60191
[SHADOWGRAPH PHOTOGRAPHY]

SHADOWGRAPH PHOTOGRAPHY

Control of wind tunnel operations using neural net interpretation of flow visualization records p 24 N95-10854
[NASA-TM-106683]

SHOCK WAVE INTERACTION

Application of scramjet engine technology to the design of ram accelerator projectiles p 19 N95-10282
Visualization of one-dimensional flow processes in a dual-mode scramjet engine p 15 N95-10465
[NASA-TM-106683]

SHOCK WAVE PROPAGATION

High speed civil transport: Sonic boom softening and aerodynamic optimization p 28 N95-11192
[NASA-CR-196397]

SHOCK WAVES

Experimental and analytical investigations of wave enhanced supersonic combustors p 14 A95-60172
[AIAA PAPER 89-2787]
Near field noise prediction requirements p 27 N95-11166
[ISVR-TR-234]

SIDESLIP

Flow-visualization study of the X-29A aircraft at high angles of attack using a 1/48-scale model p 8 N95-10858
[NASA-TM-104268]

SIKORSKY AIRCRAFT

Dynamic response of NASA Rotor Test Apparatus and Sikorsky S-76 hub mounted in the 80- by 120-Foot Wind Tunnel p 25 N95-11389
[NASA-TM-108847]

SLOTS

Computational analysis of forebody tangential slot blowing on the high alpha research vehicle p 10 N95-11367
[NASA-CR-196750]

SLOTTED WIND TUNNELS

The NASA Langley 8-foot Transonic Pressure Tunnel calibration p 8 N95-10739
[NASA-TP-3437]

SOFTWARE ENGINEERING

Advanced distributed simulation technology advanced rotary wing aircraft. Software reusability report p 20 N95-10354
[AD-A280434]

SOLID PROPELLANT COMBUSTION

Propulsion research concerning SFRR-motors p 14 N95-10083
[PB94-179520]

SOLID PROPELLANT IGNITION

Flame-spreading phenomena in the fin-slot region of a solid rocket motor p 23 N95-10296
[NASA-TM-108847]

SOLID PROPELLANT ROCKET ENGINES

Flame-spreading phenomena in the fin-slot region of a solid rocket motor p 23 N95-10296
[NASA-TM-108847]

SONIC BOOMS

High speed civil transport: Sonic boom softening and aerodynamic optimization p 28 N95-11192
[NASA-CR-196397]
MOA-MAP: A model that combines several different kinds of aircraft operations p 32 N95-11323
[NASA-TM-108847]

SOUND FIELDS

Achievements and tasks for active noise control p 29 N95-11270
[NASA-TM-108847]

SOUND PROPAGATION

At Istanbul-Ataturk Airport: measurement and analysis of noise in due of take-off time p 31 N95-11319
[NASA-TM-108847]

SOUND TRANSMISSION

Oblique incidence sound absorption of porous materials covered by perforated metal and exposed to tangential airflow p 19 A95-60165
[HTN-94-00681]

Transmission loss characteristics of aircraft sidewall systems to control cabin interior noise p 28 N95-11261
[NASA-TM-108847]

A theoretical analysis of airborne sound transfer for a resiliently mounted machine to its foundation p 30 N95-11304
[NASA-TM-108847]

Effect of constraining layer stiffness on performance of damping tile materials using finite element modelling with Rayleigh integral p 30 N95-11306
[NASA-TM-108847]

SOUND WAVES

Empirical refinements to boundary layer transition noise models p 28 N95-11262
[NASA-TM-108847]

Active control of turbomachine discrete tones p 29 N95-11275
[NASA-TM-108847]

Activities of Mitsubishi Heavy Industries Ltd. p 22 N95-10085
[PB94-179694]

Activities of Mitsubishi Heavy Industries Ltd. p 22 N95-10085
[PB94-179694]

Activities of Mitsubishi Heavy Industries Ltd. p 22 N95-10085
[PB94-179694]

Activities of Mitsubishi Heavy Industries Ltd. p 22 N95-10085
[PB94-179694]

Activities of Mitsubishi Heavy Industries Ltd. p 22 N95-10085
[PB94-179694]

Activities of Mitsubishi Heavy Industries Ltd. p 22 N95-10085
[PB94-179694]

Activities of Mitsubishi Heavy Industries Ltd. p 22 N95-10085
[PB94-179694]

Activities of Mitsubishi Heavy Industries Ltd. p 22 N95-10085
[PB94-179694]

Activities of Mitsubishi Heavy Industries Ltd. p 22 N95-10085
[PB94-179694]

Activities of Mitsubishi Heavy Industries Ltd. p 22 N95-10085
[PB94-179694]

Activities of Mitsubishi Heavy Industries Ltd. p 22 N95-10085
[PB94-179694]

The model builders
[NASA-TM-109902] p 20 N95-10552

SPACECRAFT MODELS
The model builders
[NASA-TM-109902] p 20 N95-10552

SPACECRAFT STRUCTURES
Activities of Mitsubishi Heavy Industries Ltd
[PB94-179694] p 22 N95-10085

SPACECRAFT TEMPERATURE
A programmable heater control circuit for spacecraft
[NASA-TM-108459] p 9 N95-11157

SR-71 AIRCRAFT
NASA and the SR-71: Back to the future
[NASA-TM-104290] p 13 N95-10716

STABILIZERS (FLUID DYNAMICS)
Flow-visualization study of the X-29A aircraft at high angles of attack using a 1/48-scale model
[NASA-TM-104268] p 8 N95-10858

STAGNATION TEMPERATURE
Numerical study of mixing in a high and low enthalpy supersonic test facility
p 7 N95-10467

STATIC PRESSURE
Effect of passive venting on static pressure distributions in cavities at subsonic and transonic speeds
[NASA-TM-4549] p 6 N95-10029

STEADY FLOW
Steady and unsteady three-dimensional transonic flow computations by integral equation method
[NASA-CR-196777] p 10 N95-11582

STIFFNESS
Effect of constraining layer stiffness on performance of damping tile materials using finite element modelling with Rayleigh integral
p 30 N95-11306

STOCHASTIC PROCESSES
MOAMAP: A model that combines several different kinds of aircraft operations
p 32 N95-11323

STOVL AIRCRAFT
Numerical simulation of powered-lift flows
[HTN-94-00700] p 3 A95-60179
Numerical simulation of a complete STOVL aircraft in ground effect
[AIAA PAPER 93-4880] p 4 A95-60187
Application of an integrated methodology for propulsion and airframe control design to a STOVL aircraft
[NASA-TM-106729] p 16 N95-11159

STOVL Control Integration Program
[NASA-CR-195358] p 18 N95-11487

STRATOSPHERE
Three dimensional model calculations of the global dispersion of high speed aircraft exhaust and implications for stratospheric ozone loss
p 26 N95-10657

STRINGERS
Effect of constraining layer stiffness on performance of damping tile materials using finite element modelling with Rayleigh integral
p 30 N95-11306

STRUCTURAL ANALYSIS
Advanced composites structural concepts and materials technologies for primary aircraft structures. Structural response and failure analysis: ISPAN modules users manual
[NASA-CR-4449] p 12 N95-10242
Noise Con 1994: Proceedings of the 1994 National Conference on Noise Control Engineering. Progress in Noise Control for Industry
p 28 N95-11259
[LC-75-24750]

STRUCTURAL DESIGN
Advanced composites structural concepts and materials technologies for primary aircraft structures: Structural response and failure analysis
[NASA-CR-4448] p 11 N95-10240
Advanced composites structural concepts and materials technologies for primary aircraft structures. Structural response and failure analysis: ISPAN modules users manual
[NASA-CR-4449] p 12 N95-10242
Advanced composites structural concepts and materials technologies for primary aircraft structures.
Design/manufacturing concept assessment
[NASA-CR-4447] p 12 N95-10316
The use of the Regier number in the structural design with flutter constraints
[NASA-TM-109128] p 13 N95-11465

STRUCTURAL VIBRATION
Noise Con 1994: Proceedings of the 1994 National Conference on Noise Control Engineering. Progress in Noise Control for Industry
p 28 N95-11259
Active control of interior noise in a business jet using piezoceramic actuators
p 29 N95-11276
Adaptive tuned vibration absorbers: Tuning laws, tracking agility, sizing, and physical implementations
p 25 N95-11280
Broadband, wide-area active control of sound radiated from vibrating structures using local surface-mounted radiation suppression devices
p 30 N95-11283

Comments on the use of structureborne noise analysis for large commercial airplanes
p 30 N95-11287
Exact dynamic responses of periodic multi-span beams under convected pressure fields
p 25 N95-11288
A theoretical analysis of airborne sound transfer for a resiliently mounted machine to its foundation
p 30 N95-11304

SUBSONIC FLOW
Jet to freestream velocity ratio computations for a jet in a crossflow
[AIAA PAPER 93-4860] p 2 A95-60178

SUBSONIC SPEED
Effect of passive venting on static pressure distributions in cavities at subsonic and transonic speeds
[NASA-TM-4549] p 6 N95-10029
On the use of controls for subsonic transport performance improvement: Overview and future directions
p 10 N95-11408

SUBSONIC WIND TUNNELS
Optimum full-scale subsonic wind tunnel
[AIAA PAPER 86-0732] p 18 A95-60161

SUCTION
Instabilities originating from suction holes used for Laminar Flow Control (LFC)
[NASA-CR-196395] p 6 N95-10131

SUPERCRITICAL WINGS
Dryden and transonic research
[NASA-TM-104281] p 1 N95-10709

SUPERSONIC AIRCRAFT
Three dimensional model calculations of the global dispersion of high speed aircraft exhaust and implications for stratospheric ozone loss
p 26 N95-10657
The present and future of aircraft noise models: A user's perspective
p 32 N95-11324

STOVL Control Integration Program
[NASA-CR-195358] p 18 N95-11487

SUPERSONIC COMBUSTION
Experimental and analytical investigations of wave enhanced supersonic combustors
[AIAA PAPER 89-2787] p 14 A95-60172
Propulsion research concerning SFRJ-motors
[PB94-179520] p 14 N95-10083
Hydrocarbon-fueled ramjet/scramjet technology program, phase 2 extension
p 15 N95-10319
[NASA-CR-189659] p 16 N95-10466
Programmed ignition of metal compounds in a scramjet
p 7 N95-10467
Numerical study of mixing in a high and low enthalpy supersonic test facility
p 7 N95-10467
Theories of turbulent combustion in high speed flows
p 23 N95-10535

SUPERSONIC COMBUSTION RAMJET ENGINES
Experimental and analytical investigations of wave enhanced supersonic combustors
[AIAA PAPER 89-2787] p 14 A95-60172
Propulsion research concerning SFRJ-motors
[PB94-179520] p 14 N95-10083
Application of scramjet engine technology to the design of ram accelerator projectiles
p 19 N95-10282
Hydrocarbon-fueled ramjet/scramjet technology program, phase 2 extension
p 15 N95-10319
[NASA-CR-189659] p 16 N95-10466
Visualization of one-dimensional flow processes in a dual-mode scramjet engine
p 15 N95-10465
Programmed ignition of metal compounds in a scramjet
p 16 N95-10466

SUPERSONIC DIFFUSERS
A full Navier-Stokes analysis of subsonic diffuser of a bifurcated 70/30 supersonic inlet for high speed civil transport application
[NASA-TM-106637] p 8 N95-10820

SUPERSONIC FLOW
Numerical study of mixing in a high and low enthalpy supersonic test facility
p 7 N95-10467
Theories of turbulent combustion in high speed flows
p 23 N95-10535

SUPERSONIC FLUTTER
Flutter analysis of supersonic axial flow cascades using a high resolution Euler solver. Part 1: Formulation and validation
[NASA-TM-105798] p 23 N95-10244

SUPERSONIC INLETS
A full Navier-Stokes analysis of subsonic diffuser of a bifurcated 70/30 supersonic inlet for high speed civil transport application
[NASA-TM-106637] p 8 N95-10820

SUPERSONIC NOZZLES
JPRS report: Science and technology. Central Eurasia: Engineering and equipment. Gas dynamics of supersonic shortened nozzles
[JPRES-UST-94-003-L] p 22 N95-10931

SUPERSONIC SPEED
Effect of leading- and trailing-edge flaps on clipped delta wings with and without wing camber at supersonic speeds
[NASA-TM-4542] p 5 N95-10028

SUPERSONIC TRANSPORTS
Micro-measurements of mechanical properties for adhesives and composites using digital imaging technology
[NASA-CR-196111] p 22 N95-10231
The High Speed Research Program
[NASA-TM-109669] p 10 N95-10548
A full Navier-Stokes analysis of subsonic diffuser of a bifurcated 70/30 supersonic inlet for high speed civil transport application
[NASA-TM-106637] p 8 N95-10820
High speed civil transport: Sonic boom softening and aerodynamic optimization
p 28 N95-11192

SUPERSONIC TURBINES
Computational fluid dynamics study of the variable-pitch split-blade fan concept
[NASA-CR-189206] p 15 N95-10247

SUPERSONIC WIND TUNNELS
Numerical study of Gortler instability: Application to the design of a quiet supersonic wind tunnel
[PB94-184801] p 21 N95-10844

SUPPORT SYSTEMS
NASA Lewis Propulsion Systems Laboratory customer guide manual
[NASA-TM-106569] p 21 N95-10822
Integrating NOISEMAP with the Geographic Resource Analysis Support System (GRASS) to enhance environmental impact assessments and land use compatibility studies
p 31 N95-11311

SWEEP FORWARD WINGS
Aeroelastic tailoring research
[PB94-180031] p 6 N95-10135

SYSTEMS INTEGRATION
First level release of 2GCHAS for comprehensive helicopter analysis - a status report
[HTN-94-00697] p 2 A95-60176
Fly-By-Light/Power-By-Wire Requirements and Technology Workshop
[NASA-CP-10108] p 12 N95-10245

SYSTEMS SIMULATION
Advanced distributed simulation technology advanced rotary wing aircraft. Strawnman verification and validation plan for the ARWA simulator system
[AD-A280237] p 19 N95-10349
Advanced distributed simulation technology advanced rotary wing aircraft. System/segment specification. Volume 1: Simulation system module
[AD-A280238] p 20 N95-10350
Advanced distributed simulation technology advanced rotary wing aircraft. System/segment specification. Volume 3: Visual system module
[AD-A280239] p 20 N95-10351
Advanced distributed simulation technology advanced rotary wing aircraft. System/segment specification. Volume 2: Flight station module
[AD-A280432] p 20 N95-10352
Advanced distributed simulation technology advanced rotary wing aircraft. System/segment specification. Volume 5: Simulation system module AH-64D kit
[AD-A280433] p 20 N95-10353
Advanced distributed simulation technology advanced rotary wing aircraft. Software reusability report
[AD-A280434] p 20 N95-10354

T

TAIL ASSEMBLIES

Effect of leading- and trailing-edge flaps on clipped delta wings with and without wing camber at supersonic speeds
[NASA-TM-4542] p 5 N95-10028
Flow-visualization study of the X-29A aircraft at high angles of attack using a 1/48-scale model
[NASA-TM-104268] p 8 N95-10858

TAKEOFF

Determining the effects of alternative departure cutback altitudes and power settings: A case study, John Wayne Airport
p 31 N95-11320

TARGETS

Advanced composites structural concepts and materials technologies for primary aircraft structures: Structural response and failure analysis
[NASA-CR-4448] p 11 N95-10240

TECHNOLOGY UTILIZATION

General Aviation Task Force report
[NASA-TM-109950] p 1 N95-11463

TELEROBOTICS

A generic telerobotics architecture for C-5 industrial processes
[AIAA PAPER 94-1264-CP] p 27 N95-11529

TEMPERATURE CONTROL

A programmable heater control circuit for spacecraft
[NASA-TM-108459] p 9 N95-11157

TERCOM

Simulation development of a forward sensor-enhanced low-altitude guidance system
[HTN-94-00688] p 17 A95-60170

TEST CHAMBERS

Oblique incidence sound absorption of porous materials covered by perforated metal and exposed to tangential airflow
[HTN-94-00681] p 19 A95-60165

TEST EQUIPMENT

NASA Lewis Propulsion Systems Laboratory test article systems criteria
[NASA-TM-106589] p 20 N95-10446

TEST FACILITIES

Building the Integrated Test Facility: A foundation for the future
[NASA-TM-104280] p 21 N95-10738

The Western Aeronautical Test Range
[NASA-TM-104301] p 21 N95-10746

NASA Lewis Propulsion Systems Laboratory customer guide manual
[NASA-TM-106569] p 21 N95-10822

Inlet flow test calibration for a small axial compressor facility. Part 1: Design and experimental results
[NASA-TM-106719] p 16 N95-11005

TEST RANGES

The Western Aeronautical Test Range
[NASA-TM-104301] p 21 N95-10746

X-31 tailless testing
[NASA-TM-104306] p 13 N95-10751

THERMAL ANALYSIS

Radiant energy measurements from a scaled jet engine axisymmetric exhaust nozzle for a baseline code validation case
[NASA-TM-106686] p 25 N95-11409

THERMAL INSULATION

Design and evaluation of candidate pressure ports for the HYFLITE experiment
[NASA-TM-109146] p 22 N95-11003

THERMAL PROTECTION

Design and evaluation of candidate pressure ports for the HYFLITE experiment
[NASA-TM-109146] p 22 N95-11003

THIN WINGS

Effect of leading- and trailing-edge flaps on clipped delta wings with and without wing camber at supersonic speeds
[NASA-TM-4542] p 5 N95-10028

THREE DIMENSIONAL BODIES

Development of an upwind, finite-volume code with finite-rate chemistry
[NASA-CR-196749] p 9 N95-11366

THREE DIMENSIONAL FLOW

A comparison of three-dimensional nonequilibrium solution algorithms applied to hypersonic flows with stiff chemical source terms
[AIAA PAPER 93-2861] p 4 A95-60186

An aerodynamic analysis of a mixed flow turbine
[NASA-TM-106674] p 15 N95-10153

Steady and unsteady three-dimensional transonic flow computations by integral equation method
[NASA-CR-196777] p 10 N95-11582

THREE DIMENSIONAL MODELS

Three dimensional model calculations of the global dispersion of high speed aircraft exhaust and implications for stratospheric ozone loss
p 26 N95-10657

THRUST

Two-dimensional converging-diverging rippled nozzles at transonic speeds --- performed in the Langley 16-Foot Transonic Tunnel
[NASA-TP-3440] p 6 N95-10129

THRUST CONTROL

Application of an integrated methodology for propulsion and airframe control design to a STOVL aircraft
[NASA-TM-106729] p 16 N95-11159

THRUST VECTOR CONTROL

High-Alpha Research Vehicle (HARV) longitudinal controller: Design, analyses, and simulation results
[NASA-TP-3446] p 17 N95-10860

STOVL Control Integration Program

[NASA-CR-195359] p 18 N95-11487

TILES

Effect of constraining layer stiffness on performance of damping the materials using finite element modelling with Rayleigh integral
p 30 N95-11306

TILT ROTOR AIRCRAFT

Wing download reduction using vortex trapping plates
[HTN-94-00710] p 4 A95-60188

FAA vertical flight bibliography
[DOT/FAA/RD-94/17] p 14 N95-11684

TILTING ROTORS

Study of noise on a small-scale hovering tilt rotor
[HTN-94-00712] p 5 A95-60190

Aerodynamic interactions between a rotor and wing in hover
[HTN-94-00714] p 5 A95-60192

TOLLIEN-SCHLICHTING WAVES

Instabilities originating from suction holes used for Laminar Flow Control (LFC)
[NASA-CR-196395] p 6 N95-10131

TRAILING EDGE FLAPS

Effect of leading- and trailing-edge flaps on clipped delta wings with and without wing camber at supersonic speeds
[NASA-TM-4542] p 5 N95-10028

TRAILING EDGES

Two-dimensional converging-diverging rippled nozzles at transonic speeds --- performed in the Langley 16-Foot Transonic Tunnel
[NASA-TP-3440] p 6 N95-10129

TRANSDUCERS

Low frequency ultrasonic nondestructive inspection of aluminum/adhesive fuselage lap splices
[DE94-014242] p 24 N95-11135

TRANSFER FUNCTIONS

Broadband, wide-area active control of sound radiated from vibrating structures using local surface-mounted radiation suppression devices
p 30 N95-11283

TRANSITION FLIGHT

Application of an integrated methodology for propulsion and airframe control design to a STOVL aircraft
[NASA-TM-106729] p 16 N95-11159

TRANSMISSION LOSS

Transmission loss characteristics of aircraft sidewall systems to control cabin interior noise
p 28 N95-11261

A theoretical analysis of airborne sound transfer for a resiliently mounted machine to its foundation
p 30 N95-11304

TRANSONIC FLIGHT

Transonic flight test of a laminar flow leading edge with surface excrescences
[NASA-TM-4597] p 9 N95-11158

TRANSONIC FLOW

Computational analysis of forebody tangential slot blowing on the high alpha research vehicle
[NASA-CR-196750] p 10 N95-11367

TRANSONIC LOSS

Dryden and transonic research
[NASA-TM-104281] p 1 N95-10709

Steady and unsteady three-dimensional transonic flow computations by integral equation method
[NASA-CR-196777] p 10 N95-11582

TRANSONIC FLUTTER

Aeroelastic tailoring research
[PB94-180031] p 6 N95-10135

Computations of unsteady aerodynamic loads around oscillating wings. Part 1: Formulation
[PB94-180043] p 7 N95-10136

Computations of unsteady aerodynamic loads around oscillating wings. Part 2: Computed results and discussions
[PB94-180056] p 7 N95-10137

TRANSONIC SPEED

Effect of passive venting on static pressure distributions in cavities at subsonic and transonic speeds
[NASA-TM-4549] p 6 N95-10029

Two-dimensional converging-diverging rippled nozzles at transonic speeds --- performed in the Langley 16-Foot Transonic Tunnel
[NASA-TP-3440] p 6 N95-10129

TRANSONIC WIND TUNNELS

The NASA Langley 8-foot Transonic Pressure Tunnel calibration
[NASA-TP-3437] p 8 N95-10739

TRANSPORT AIRCRAFT

Reanalysis of European flight loads data
[AD-A282052] p 9 N95-11179

On the use of controls for subsonic transport performance improvement: Overview and future directions
[NASA-TM-4605] p 10 N95-11408

TRANSPORTATION

Noise Con 1994: Proceedings of the 1994 National Conference on Noise Control Engineering. Progress in Noise Control for Industry
[LC-75-24750] p 28 N95-11259

TRILOGY

Brush seal performance and durability issues based on T-700 engine test results
[NASA-TM-106502] p 22 N95-11483

TUNING

Adaptive tuned vibration absorbers: Tuning laws, tracking agility, sizing, and physical implementations
p 25 N95-11280

TURBINE ENGINES

NASA Lewis Propulsion Systems Laboratory test article systems criteria
[NASA-TM-106589] p 20 N95-10446

TURBINES

An aerodynamic analysis of a mixed flow turbine
[NASA-TM-106674] p 15 N95-10153

TURBOCOMPRESSORS

Inlet flow test calibration for a small axial compressor facility. Part 1: Design and experimental results
[NASA-TM-106719] p 16 N95-11005

TURBOFAN ENGINES

Computational fluid dynamics study of the variable-pitch split-blade fan concept
[NASA-CR-189206] p 15 N95-10247

Fan noise research at NASA
[NASA-CR-189206] p 28 N95-11260

Active control of turbomachine discrete tones
p 29 N95-11275

Analytical investigation of adaptive control of radiated inlet noise from turbofan engines
p 30 N95-11277

TURBOFANS

Computational fluid dynamics study of the variable-pitch split-blade fan concept
[NASA-CR-189206] p 15 N95-10247

Fan noise research at NASA
[NASA-CR-189206] p 28 N95-11260

TURBOJET ENGINE CONTROL

Application of an integrated methodology for propulsion and airframe control design to a STOVL aircraft
[NASA-TM-106729] p 16 N95-11159

TURBULENCE

An experimental investigation of wing tip turbulence with applications to aerodynamic
[AIAA PAPER 86-1918] p 1 A95-60164

Empirical refinements to boundary layer transition noise models
p 28 N95-11262

Effect of weak periodic pressure gradient on streamwise vortices near a wall
p 29 N95-11263

TURBULENCE MODELS

Dynamic stall of an oscillating wing. Part 1: Evaluation of turbulence models
[AIAA PAPER 93-3403] p 3 A95-60184

A comparison of turbulence models in computing multi-element airfoil flows
[AIAA PAPER 94-0291] p 4 A95-60185

TURBULENT BOUNDARY LAYER

Empirical refinements to boundary layer transition noise models
p 28 N95-11262

Exact dynamic responses of periodic multi-span beams under connected pressure fields
p 25 N95-11288

TURBULENT COMBUSTION

Theories of turbulent combustion in high speed flows
[AD-A280933] p 23 N95-10535

TURBULENT FLOW

Agglomeration multigrad for viscous turbulent flows
[NASA-CR-194953] p 8 N95-10848

Empirical refinements to boundary layer transition noise models
p 28 N95-11262

Effect of weak periodic pressure gradient on streamwise vortices near a wall
p 29 N95-11263

TVD SCHEMES

Development of an upwind, finite-volume code with finite-rate chemistry
[NASA-CR-196749] p 9 N95-11366

TWISTED WINGS

Effect of leading- and trailing-edge flaps on clipped delta wings with and without wing camber at supersonic speeds
[NASA-TM-4542] p 5 N95-10028

U

UH-60A HELICOPTER

Validation of the dynamic response of a blade-element UH-60 simulation model in hovering flight
[HTN-94-00663] p 18 A95-60155

ULTRASONIC TESTS

Low frequency ultrasonic nondestructive inspection of aluminum/adhesive fuselage lap splices
[DE94-014242] p 24 N95-11135

UNCAMBERED WINGS

Effect of leading- and trailing-edge flaps on clipped delta wings with and without wing camber at supersonic speeds
[NASA-TM-4542] p 5 N95-10028

UNDER SURFACE BLOWING

Wing download reduction using vortex trapping plates
[HTN-94-00710] p 4 A95-60188

UNSTEADY AERODYNAMICS

Dynamic stall of an oscillating wing. Part 1: Evaluation of turbulence models
[AIAA PAPER 93-3403] p 3 A95-60184

Effect of wind tunnel acoustic modes on linear oscillating cascade aerodynamics
[HTN-94-00760] p 14 A95-60199

Computations of unsteady aerodynamic loads around oscillating wings. Part 1: Formulation [PB94-180049] p 7 N95-10136

Computations of unsteady aerodynamic loads around oscillating wings. Part 2: Computed results and discussions [PB94-180056] p 7 N95-10137

Flutter analysis of supersonic axial flow cascades using a high resolution Euler solver. Part 1: Formulation and validation [NASA-TM-105798] p 23 N95-10244

UNSTEADY FLOW

Oscillating airfoil compressible dynamic stall studies [HTN-94-00704] p 3 A95-60183

LDV measurements in dynamically separated flows [ISBN 0-8194-1311-9] p 5 A95-60191

A study of compressibility effects on dynamic stall of rapidly pitching airfoils [HTN-94-00715] p 5 A95-60193

Effects of a forward-swept front rotor on the flowfield of a counterrotation propeller [NASA-TM-106671] p 7 N95-10148

Numerical study of Gortler instability: Application to the design of a quiet supersonic wind tunnel [PB94-184801] p 21 N95-10844

Effect of weak periodic pressure gradient on streamwise vortices near a wall p 29 N95-11263

Steady and unsteady three-dimensional transonic flow computations by integral equation method [NASA-CR-196777] p 10 N95-11582

UPPER SURFACE BLOWING

Wing download reduction using vortex trapping plates [HTN-94-00710] p 4 A95-60188

An assessment of upper surface blowing for the reduction of tilt rotor download [HTN-94-00711] p 5 A95-60189

UPWIND SCHEMES (MATHEMATICS)

Development of an upwind, finite-volume code with finite-rate chemistry [NASA-CR-196749] p 9 N95-11366

USER MANUALS (COMPUTER PROGRAMS)

Advanced composites structural concepts and materials technologies for primary aircraft structures. Structural response and failure analysis: ISPAN modules users manual [NASA-4449] p 12 N95-10242

Modeling improvements and users manual for axial-flow turbine off-design computer code AXOD [NASA-CR-195370] p 8 N95-10853

A users manual for the method of moments Aircraft Modeling Code (AMC), version 2 [NASA-CR-196445] p 24 N95-11252

V**V-22 AIRCRAFT**

An assessment of upper surface blowing for the reduction of tilt rotor download [HTN-94-00711] p 5 A95-60189

VELOCITY DISTRIBUTION

Jet to freestream velocity ratio computations for a jet in a crossflow

VELOCITY MEASUREMENT

Optimum full-scale subsonic wind tunnel [AIAA PAPER 86-0732] p 18 A95-60161

LDV measurements in dynamically separated flows [ISBN 0-8194-1311-9] p 5 A95-60191

VENTING

Effect of passive venting on static pressure distributions in cavities at subsonic and transonic speeds [NASA-TM-4549] p 6 N95-10029

VENTS

Effect of passive venting on static pressure distributions in cavities at subsonic and transonic speeds [NASA-TM-4549] p 6 N95-10029

VERTICAL AIR CURRENTS

Vertical wind estimation from horizontal wind measurements p 26 N95-10567

VERTICAL FLIGHT

FAA vertical flight bibliography

IDOT/FAA/RD-94/17] p 14 N95-11684

VERTICAL PERCEPTION

Evaluation of simulation motion fidelity criteria in the vertical and directional axes [HTN-94-00666] p 18 A95-60156

VIBRATION DAMPING

Noise Con 1994: Proceedings of the 1994 National Conference on Noise Control Engineering. Progress in Noise Control for Industry [ILC-75-24750] p 28 N95-11259

Achievements and tasks for active noise control p 29 N95-11270

Active control of complex noise problems using a broadband, multichannel controller p 26 N95-11271

Active control of interior noise in a business jet using piezoceramic actuators p 29 N95-11276

Adaptive tuned vibration absorbers: Tuning laws, tracking agility, sizing, and physical implementations p 25 N95-11280

Comments on the use of structureborne noise analysis for large commercial airplanes p 30 N95-11287

Exact dynamic responses of periodic multi-span beams under connected pressure fields p 25 N95-11288

Effect of constraining layer stiffness on performance of damping tile materials using finite element modelling with Rayleigh integral p 30 N95-11306

VIBRATION EFFECTS

Effects of vibration on inertial wind-tunnel model attitude measurement devices [NASA-TM-109083] p 21 N95-11466

VIBRATION ISOLATORS

Adaptive tuned vibration absorbers: Tuning laws, tracking agility, sizing, and physical implementations p 25 N95-11280

VIBRATION MODE

Effect of wind tunnel acoustic modes on linear oscillating cascade aerodynamics [HTN-94-00760] p 14 A95-60199

Exact dynamic responses of periodic multi-span beams under connected pressure fields p 25 N95-11288

VISCOELASTICITY

Effect of constraining layer stiffness on performance of damping tile materials using finite element modelling with Rayleigh integral p 30 N95-11306

VISCOUS FLOW

Computation of nonequilibrium viscous flows in arc-jet wind tunnel nozzles [AIAA PAPER 94-0254] p 2 A95-60173

Agglomeration multigrid for viscous turbulent flows [NASA-CR-194953] p 8 N95-10848

Development of an upwind, finite-volume code with finite-rate chemistry [NASA-CR-196749] p 9 N95-11366

VISUAL CONTROL

The 4-D approach to visual control of autonomous systems [AIAA PAPER 94-1243-CP] p 27 N95-11513

VORTEX FLAPS

Wing download reduction using vortex trapping plates [HTN-94-00710] p 4 A95-60188

VORTEX SHEDDING

Numerical simulation of the flow about the F-18 HARV at high angle of attack [NASA-CR-196396] p 9 N95-10940

VORTICES

Instabilities originating from suction holes used for Laminar Flow Control (LFC) [NASA-CR-196395] p 6 N95-10131

Numerical study of Gortler instability: Application to the design of a quiet supersonic wind tunnel [PB94-184801] p 21 N95-10844

Flow-visualization study of the X-29A aircraft at high angles of attack using a 1/48-scale model [NASA-TM-104268] p 8 N95-10858

Effect of weak periodic pressure gradient on streamwise vortices near a wall p 29 N95-11263

Potential impacts of advanced aerodynamic technology on air transportation system productivity [NASA-TM-109154] p 10 N95-11489

W**WAKES**

Control of wind tunnel operations using neural net interpretation of flow visualization records [NASA-TM-106683] p 24 N95-10854

WALL FLOW

Effect of weak periodic pressure gradient on streamwise vortices near a wall p 29 N95-11263

WARNING SYSTEMS

Airborne Windshear Detection and Warning Systems. Fifth and Final Combined Manufacturers' and Technologists' Conference, part 1 [NASA-CR-10139-PT-1] p 10 N95-10566

WATER TUNNEL TESTS

Flow-visualization study of the X-29A aircraft at high angles of attack using a 1/48-scale model [NASA-TM-104268] p 8 N95-10858

WEAR TESTS

Brush seal performance and durability issues based on T-700 engine test results [NASA-TM-106502] p 22 N95-11483

WIND EFFECTS

Characteristics of a dry, pulsating microburst at Denver Stapleton Airport p 26 N95-10568

WIND MEASUREMENT

Vertical wind estimation from horizontal wind measurements p 26 N95-10567

WIND SHEAR

Airborne Windshear Detection and Warning Systems. Fifth and Final Combined Manufacturers' and Technologists' Conference, part 1 [NASA-CR-10139-PT-1] p 10 N95-10566

Vertical wind estimation from horizontal wind measurements p 26 N95-10567

Characteristics of a dry, pulsating microburst at Denver Stapleton Airport p 26 N95-10568

Future enhancements to ground-based microburst detection p 11 N95-10570

Determining F-factor using ground-based Doppler radar: Validation and results p 11 N95-10571

WIND TUNNEL CALIBRATION

The NASA Langley 8-foot Transonic Pressure Tunnel calibration [NASA-TP-3437] p 8 N95-10739

WIND TUNNEL MODELS

Effects of vibration on inertial wind-tunnel model attitude measurement devices [NASA-TM-109083] p 21 N95-11466

WIND TUNNEL NOZZLES

Computation of nonequilibrium viscous flows in arc-jet wind tunnel nozzles [AIAA PAPER 94-0254] p 2 A95-60173

WIND TUNNEL TESTS

An experimental investigation of wing tip turbulence with applications to aerodynamic [AIAA PAPER 86-1918] p 1 A95-60164

Wing download reduction using vortex trapping plates [HTN-94-00710] p 4 A95-60188

Effect of wind tunnel acoustic modes on linear oscillating cascade aerodynamics [HTN-94-00760] p 14 A95-60199

Effect of leading- and trailing-edge flaps on clipped delta wings with and without wing camber at supersonic speeds [NASA-TM-4542] p 5 N95-10028

Two-dimensional converging-diverging rippled nozzles at transonic speeds --- performed in the Langley 16-Foot Transonic Tunnel [NASA-TP-3440] p 6 N95-10129

Instabilities originating from suction holes used for Laminar Flow Control (LFC) [NASA-CR-196395] p 6 N95-10131

Numerical study of mixing in a high and low enthalpy supersonic test facility p 7 N95-10467

Control of wind tunnel operations using neural net interpretation of flow visualization records [NASA-TM-106683] p 24 N95-10854

Dynamic response of NASA Rotor Test Apparatus and Sikorsky S-76 hub mounted in the 80- by 120-Foot Wind Tunnel [NASA-TM-108847] p 25 N95-11389

WIND TUNNELS

Aeroacoustic probe design for microphone to reduce flow-induced self-noise [AIAA PAPER 93-4343] p 19 A95-60163

Oblique incidence sound absorption of porous materials covered by perforated metal and exposed to tangential airflow [HTN-94-00681] p 19 A95-60165

Control of wind tunnel operations using neural net interpretation of flow visualization records [NASA-TM-106683] p 24 N95-10854

WING CAMBER

Effect of leading- and trailing-edge flaps on clipped delta wings with and without wing camber at supersonic speeds [NASA-TM-4542] p 5 N95-10028

WING LOADING

Aeroelastic tailoring research [PB94-180031] p 6 N95-10135

Computations of unsteady aerodynamic loads around oscillating wings. Part 1: Formulation [PB94-180049] p 7 N95-10136

Computations of unsteady aerodynamic loads around oscillating wings. Part 2: Computed results and discussions [PB94-180056] p 7 N95-10137

WING OSCILLATIONS

Dynamic stall of an oscillating wing. Part 1: Evaluation of turbulence models [AIAA PAPER 93-3403] p 3 A95-60184

Computations of unsteady aerodynamic loads around oscillating wings. Part 1: Formulation [PB94-180049] p 7 N95-10136

Computations of unsteady aerodynamic loads around oscillating wings. Part 2: Computed results and discussions [PB94-180056] p 7 N95-10137

WING PANELS

Steady and unsteady three-dimensional transonic flow computations by integral equation method [NASA-CR-196777] p 10 N95-11582

WING SLOTS**WING SLOTS**

Transonic flight test of a laminar flow leading edge with surface excrescences
[NASA-TM-4597] p 9 N95-11158

WING TIP VORTICES

An experimental investigation of wing tip turbulence with applications to aerodynamic
[AIAA PAPER 86-1918] p 1 A95-60164
3D visualization of unsteady 2D airplane wake vortices
[NASA-CR-194931] p 27 N95-11593

WINGS

Dynamic stall of an oscillating wing. Part 1: Evaluation of turbulence models
[AIAA PAPER 93-3403] p 3 A95-60184
Wing download reduction using vortex trapping plates
[HTN-94-00710] p 4 A95-60188
An assessment of upper surface blowing for the reduction of lift rotor download
[HTN-94-00711] p 5 A95-60189
Aerodynamic interactions between a rotor and wing in hover
[HTN-94-00714] p 5 A95-60192
Advanced composites structural concepts and materials technologies for primary aircraft structures: Design/manufacturing concept assessment
[NASA-CR-4447] p 12 N95-10316
The use of the Regier number in the structural design with flutter constraints
[NASA-TM-109128] p 13 N95-11465

X**X-14 AIRCRAFT**

Design of a model following, state variable feedback controller for the X-14 VTOL aircraft
[HTN-94-00685] p 16 A95-60168

X-29 AIRCRAFT

Flow-visualization study of the X-29A aircraft at high angles of attack using a 1/48-scale model
[NASA-TM-104288] p 8 N95-10858

X-31 AIRCRAFT

Aero-Space Plane: Flexible access to space
[NASA-TM-109904] p 22 N95-10553
X-31 resource tape
[NASA-TM-104300] p 13 N95-10745
X-31 tailless testing
[NASA-TM-104306] p 13 N95-10751
High-angle-of-attack yawing moment asymmetry of the X-31 aircraft from flight test
[NASA-CR-186030] p 13 N95-11410

Y**YAWING MOMENTS**

Computational analysis of forebody tangential slot blowing on the high alpha research vehicle
[NASA-CR-196750] p 10 N95-11367
High-angle-of-attack yawing moment asymmetry of the X-31 aircraft from flight test
[NASA-CR-186030] p 13 N95-11410

Z**ZERO ANGLE OF ATTACK**

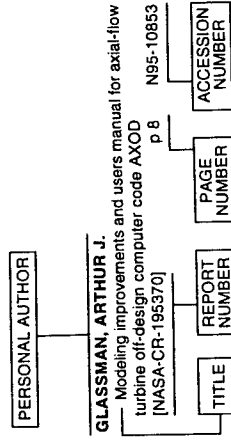
Effects of a forward-swept front rotor on the flowfield of a counterrotation propeller
[NASA-TM-106671] p 7 N95-10148

PERSONAL AUTHOR INDEX

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Typical Personal Author Index Listing



Listings in this index are arranged alphabetically by personal author. The title of the document is used to provide a brief description of the subject matter. The report number helps to indicate the type of document (e.g., NASA report, translation, NASA contractor report). The page and accession numbers are located beneath and to the right of the title. Under any one author's name the accession numbers are arranged in sequence.

A

- ABELOFF, PATRICIA A.**
Numerical simulation of powered-lift flows
[HTN-94-00700] p 3 A95-60179
- ADELMAN, HENRY G.**
Experimental and analytical investigations of wave enhanced supersonic combustors
[AIAA PAPER 89-2787] p 14 A95-60172
- AHMAD, J. U.**
Navier-Stokes simulation of rotor-body flowfield in hover using overset grids
[PAPER C15] p 1 A95-60160
- ALAKSIN, P.**
Flame-spreading phenomena in the fin-slot region of a solid rocket motor
p 23 N95-10296
- ALBO, E. D.**
Determining F-factor using ground-based Doppler radar: Validation and results
p 11 N95-10571
- ALLEN, CHRISTOPHER S.**
On the scaling of small-scale jet noise to large scale
[AIAA PAPER 92-02109] p 27 A95-60166
- ALLEW, CRISTOPHER S.**
Aeroacoustic probe design for microphone to reduce flow-induced self-noise
[AIAA PAPER 93-4343] p 19 A95-60163
- AMATRUDO, GARY**
Design and flight evaluation of an integrated navigation and near-terrain helicopter guidance system for night-time and adverse weather operations
[NASA-TM-108837] p 11 N95-10846
- AMIDI, OMEAD**
Research on an autonomous vision-guided helicopter
[AIAA PAPER 94-1240-CP] p 18 N95-11510
- ANDERSON, BERNHARD H.**
A full Navier-Stokes analysis of subsonic diffuser of a bifurcated 70/30 supersonic inlet for high speed civil transport application
[NASA-TM-106637] p 8 N95-10820
- ANSCHUETZ, ROBERT**
Advanced distributed simulation technology advanced rotary wing aircraft. System/segment specification. Volume 1: Simulation system module p 20 N95-10350 [AD-A280238]

B

- BACKES, PAUL G.**
A generic telerobotics architecture for C-5 industrial processes
[AIAA PAPER 94-1264-CP] p 27 N95-11529
- BACON, BARTON J.**
High-Alpha Research Vehicle (HARV) longitudinal controller: Design, analyses, and simulation results
[NASA-TP-3446] p 17 N95-10860
- BAEDER, J. D.**
Recent advances in Euler and Navier-Stokes methods for calculating helicopter rotor aerodynamics and acoustics
[HTN-94-00886] p 2 A95-60169
- BAILEY, DON**
Adaptive tuned vibration absorbers: Tuning laws, tracking agility, sizing, and physical implementations
p 25 N95-11280
- BAKER, ROBERT L.**
Fly-By-Light/Power-By-Wire Requirements and Technology Workshop
[NASA-CP-10108] p 12 N95-10245
- BAKHLE, MILIND A.**
Flutter analysis of supersonic axial flow cascades using a high resolution Euler solver. Part 1: Formulation and validation
[NASA-TM-105798] p 23 N95-10244
- BALAKRISHNA, S.**
Effects of vibration on inertial wind-tunnel model attitude measurement devices
[NASA-TM-109083] p 21 N95-11466
- BALLIN, MARK G.**
Validation of the dynamic response of a blade-element UH-60 simulation model in hovering flight
[HTN-94-00663] p 18 A95-60155
- BAUMEISTER, JOSEPH F.**
Radiant energy measurements from a scaled jet engine axisymmetric exhaust nozzle for a baseline code validation case
[NASA-TM-106686] p 25 N95-11409
- BAYHA, TOM D.**
Advanced composites structural concepts and materials technologies for primary aircraft structures: Design/manufacturing concept assessment
[NASA-CR-4447] p 12 N95-10316
- BEARD, ANDREW**
Adaptive tuned vibration absorbers: Tuning laws, tracking agility, sizing, and physical implementations
p 25 N95-11280
- BILANIN, ALAN J.**
Wing download reduction using vortex trapping plates
[HTN-94-00710] p 4 A95-60188
- BISHOP, M. T.**
Novel matrix resins for composites for aircraft primary structures, phase 1
[NASA-CR-189657] p 23 N95-10318

- BJARKE, LISA J.**
Flow-visualization study of the X-29A aircraft at high angles of attack using a 1/48-scale model
[NASA-TM-104268] p 8 N95-10858
- BORTINS, RICHARD**
ACSUNT inner loop flight control design study
[NASA-CR-196316] p 17 N95-11223
- BOURGEOIS, KAREN**
Advanced distributed simulation technology advanced rotary wing aircraft. Software reusability report
[AD-A280434] p 20 N95-10354
- BRANSON, ROGER**
Advanced distributed simulation technology advanced rotary wing aircraft. System/segment specification. Volume 1: Simulation system module p 19 N95-10349 [AD-A280237]
- BRANSON, ROGER**
Advanced distributed simulation technology advanced rotary wing aircraft. System/segment specification. Volume 2: Flight station module p 20 N95-10350 [AD-A280238]
- BRANSON, ROGER**
Advanced distributed simulation technology advanced rotary wing aircraft. System/segment specification. Volume 3: Visual system module p 20 N95-10351 [AD-A280239]
- BRANSON, ROGER**
Advanced distributed simulation technology advanced rotary wing aircraft. System/segment specification. Volume 4: Flight station module p 20 N95-10352 [AD-A280432]
- BRANSON, ROGER**
Advanced distributed simulation technology advanced rotary wing aircraft. System/segment specification. Volume 5: Simulation system module AH-64D kit p 20 N95-10353 [AD-A280433]
- BRANSON, ROGER**
Advanced distributed simulation technology advanced rotary wing aircraft. Software reusability report
[AD-A280434] p 20 N95-10354
- BRANSON, HAL F.**
Micro-measurements of mechanical properties for adhesives and composites using digital imaging technology
[NASA-CR-196111] p 22 N95-10231
- BROOKS, CUYLER W., JR.**
The NASA Langley 8-foot Transonic Pressure Tunnel calibration
[NASA-TP-3437] p 8 N95-10739
- BROWN, PHILIP W.**
High-Alpha Research Vehicle (HARV) longitudinal controller: Design, analyses, and simulation results
[NASA-TP-3446] p 17 N95-10860
- BROWN, ROBERT E.**
INM contour validation: A case study
p 31 N95-11321
- BRUZA, K. J.**
Novel matrix resins for composites for aircraft primary structures, phase 1
[NASA-CR-189657] p 23 N95-10318
- BUEHLE, RALPH D.**
Effects of vibration on inertial wind-tunnel model attitude measurement devices
[NASA-TM-109083] p 21 N95-11466
- BUFFUM, D. H.**
Effect of wind tunnel acoustic modes on linear oscillating cascade aerodynamics
[HTN-94-00760] p 14 A95-60189
- BUGGELE, ALVIN E.**
Control of wind tunnel operations using neural net interpretation of flow visualization records
[NASA-TM-106683] p 24 N95-10854
- BURDISO, RICARDO A.**
Analytical investigation of adaptive control of radiated inlet noise from turbofan engines
p 30 N95-11277
- BURROUGHS, COURTNEY B.**
A theoretical analysis of airborne sound transfer for a resiliently mounted machine to its foundation
p 30 N95-11304
- BUSHNELL, DENNIS M.**
Potential impacts of advanced aerodynamic technology on air transportation system productivity
[NASA-TM-109154] p 10 N95-11489
- BUTLER, RICKY W.**
Formal design and verification of a reliable computing platform for real-time control (phase 3 results)
[NASA-TM-109140] p 33 N95-10873

B-1

BUTZEL, LEO M.
Comments on the use of structureborne noise analysis for large commercial airplanes p 30 N95-11287

C

CAMBIER, JEAN-LUC
Experimental and analytical investigations of wave enhanced supersonic combustors [AIAA PAPER 89-2787] p 14 A95-60172

CAMPBELL, STEVEN D.
Future enhancements to ground-based microburst detection p 11 N95-10570

CARLSON, JOHN R.
Two-dimensional converging-diverging rippled nozzles at transonic speeds [NASA-TP-3440] p 6 N95-10129

CARR, L. W.
Interferometry and computational studies of an oscillating airfoil compressible dynamic stall flow field [HTN-94-00703] p 3 A95-60182

CARR, LAWRENCE W.
A study of compressibility effects on dynamic stall of rapidly pitching airfoils [HTN-94-00715] p 5 A95-60193

CARZOO, SUSAN W.
High-Alpha Research Vehicle (HARV) longitudinal controller: Design, analyses, and simulation results [NASA-TP-3446] p 17 N95-10860

CHANDRASEKHARA, M. S.
Interferometry and computational studies of an oscillating airfoil compressible dynamic stall flow field [HTN-94-00703] p 3 A95-60182

Oscillating airfoil compressible dynamic stall studies [HTN-94-00704] p 3 A95-60183

LDV measurements in dynamically separated flows [ISBN 0-8194-1311-9] p 5 A95-60191

A study of compressibility effects on dynamic stall of rapidly pitching airfoils p 5 A95-60193

CHAWLA, KALPANA
Numerical simulation of powered-lift flows [HTN-94-00700] p 3 A95-60179

Numerical simulation of a complete STOVL aircraft in ground effect [AIAA PAPER 93-4880] p 4 A95-60187

CHEUNG, SAMSON
High speed civil transport: Sonic boom softening and aerodynamic optimization [NASA-CR-196397] p 28 N95-11192

CHILDERS, BROOKS A.
Computer-aided light sheet flow visualization using photogrammetry [NASA-TP-3416] p 26 N95-10859

CHOUDHURY, P. ROY
Programmed ignition of metal compounds in a scramjet p 16 N95-10466

CHU, ROBERT L.
Advanced composites structural concepts and materials technologies for primary aircraft structures: Design/manufacturing concept assessment [NASA-CR-4447] p 12 N95-10316

CIVINSKAS, KESTUTIS C.
An aerodynamic analysis of a mixed flow turbine [NASA-TM-106674] p 15 N95-10153

CLARK, RAYMOND
Design and flight evaluation of an integrated navigation and near-terrain helicopter guidance system for night-time and adverse weather operations [NASA-TM-108637] p 11 N95-10846

CLECKNER, CRAIG S.
Design and evaluation of candidate pressure ports for the HYFLITE experiment [NASA-TM-109146] p 22 N95-11003

COBLEIGH, BRENT R.
High-angle-of-attack yawing moment asymmetry of the X-31 aircraft from flight test [NASA-CR-186030] p 13 N95-11410

COOK, BREND A.
Assessing effects of military aircraft noise on residential property values near airbases p 31 N95-11310

CORLISS, L. D.
Design of a model following, state variable feedback controller for the X-14 VTOL aircraft [HTN-94-00685] p 16 A95-60168

COTTON, STACEY J.
Flow-visualization study of the X-29A aircraft at high angles of attack using a 1/48-scale model [NASA-TM-104266] p 8 N95-10858

COVELL, PETER F.
Effect of leading- and trailing-edge flaps on clipped delta wings with and without wing camber at supersonic speeds [NASA-TM-45421] p 5 N95-10028

DURBIN, PAUL A.
A comparison of turbulence models in computing multi-element airfoil flows [AIAA PAPER 94-0291] p 4 A95-60185

E

EJIRI, H.
Aeroelastic tailoring research [PB94-180031] p 6 N95-10135

EKATERINARIS, J. A.
Interferometry and computational studies of an oscillating airfoil compressible dynamic stall flow field [HTN-94-00703] p 3 A95-60182

Dynamic stall of an oscillating wing. Part 1: Evaluation of turbulence models [AIAA PAPER 93-3403] p 3 A95-60184

ELMORE, K. L.
Determining F-factor using ground-based Doppler radar: Validation and results p 11 N95-10571

ELMQUIST, A. R.
Computational fluid dynamics study of the variable-pitch split-blade fan concept [NASA-CR-189206] p 15 N95-10247

ESPANA, MARTIN
On the use of controls for subsonic transport performance improvement: Overview and future directions [NASA-TM-4605] p 10 N95-11408

F

FARNAT, C.
High performance parallel analysis of coupled problems for aircraft propulsion p 23 N95-10132

FAYE, ROBERT E.
An assessment of upper surface blowing for the reduction of tilt rotor download p 5 A95-60189

FELIPPA, C. A.
High performance parallel analysis of coupled problems for aircraft propulsion [NASA-CR-195355] p 23 N95-10132

FELKER, FORT F.
An assessment of upper surface blowing for the reduction of tilt rotor download [HTN-94-00711] p 5 A95-60189

Aerodynamic interactions between a rotor and wing in hover [HTN-94-00714] p 5 A95-60192

FIDELL, SANFORD
Assessing effects of military aircraft noise on residential property values near airbases p 31 N95-11310

FISHER, M. J.
Near field noise prediction requirements [ISVR-TP-234] p 27 N95-11166

FLEETER, S.
Effect of wind tunnel acoustic modes on linear oscillating cascade aerodynamics p 14 A95-60199

FLEETER, SANFORD
Active control of turbomachine discrete tones p 29 N95-11275

FOSTER, JOHN F.
High-Alpha Research Vehicle (HARV) longitudinal controller: Design, analyses, and simulation results [NASA-TP-3446] p 17 N95-10860

FRY, HOWARD
Advanced distributed simulation technology advanced rotary wing aircraft. Strawman verification and validation plan for the ARWA simulator system p 19 N95-10349

FULLER, CHRIS R.
Active control of interior noise in a business jet using piezoceramic actuators p 29 N95-11276

G

GARG, SANJAY
Application of an integrated methodology for propulsion and airframe control design to a STOVL aircraft [NASA-TM-106729] p 16 N95-11159

GEE, KEN
Computational analysis of forebody tangential slot blowing on the high alpha research vehicle [NASA-CR-196750] p 10 N95-11367

GERSTEIN, M.
Programmed ignition of metal compounds in a scramjet p 16 N95-10466

GIBBS, GARY P.
Active control of interior noise in a business jet using piezoceramic actuators p 29 N95-11276

K

- GILYARD, GLENN**
On the use of controls for subsonic transport performance improvement: Overview and future directions [NASA-TM-4605] p 10 N95-11408
- GLASSMAN, ARTHUR J.**
Modeling improvements and users manual for axial-flow turbine off-design computer code AXOD [NASA-CR-195370] p 8 N95-10853
- GLEGG, STEWART A. L.**
Noise Con 1994: Proceedings of the 1994 National Conference on Noise Control Engineering. Progress in Noise Control for Industry p 28 N95-11259
- GLOVER, BILLY M.**
Transmission loss characteristics of aircraft sidewall systems to control cabin interior noise p 28 N95-11261
- GODSCHALX, J. P.**
Novel matrix resins for composites for aircraft primary structures, phase 1 [NASA-CR-189657] p 23 N95-10318
- GOKCEN, TAHIR**
Computation of nonequilibrium viscous flows in arc-jet wind tunnel nozzles [AIAA PAPER 94-0254] p 2 A95-60173
- GOODRICH, R. K.**
Determining F-factor using ground-based Doppler radar: Validation and results p 11 N95-10571
- GORA, YU. V.**
JPRS report: Science and technology. Central Eurasia: Engineering and equipment. Gas dynamics of supersonic shortened nozzles [JPRES-UST-94-003-L] p 22 N95-10931
- GOSSETT, T. D.**
Design of a model following, state variable feedback controller for the X-14 VTOL aircraft [HTN-94-00685] p 16 A95-60168
- GREBENYUK, L. Z.**
JPRES report: Science and technology. Central Eurasia: Engineering and equipment. Gas dynamics of supersonic shortened nozzles [JPRES-UST-94-003-L] p 22 N95-10931
- GROENEWEG, JOHN F.**
Fan noise research at NASA p 28 N95-11260
- GUMASTE, U.**
High performance parallel analysis of coupled problems for aircraft propulsion [NASA-CR-195355] p 23 N95-10132
- HARR, JOHN W.**
Advanced composites structural concepts and materials technologies for primary aircraft structures: Structural response and failure analysis [NASA-CR-4448] p 11 N95-10240
- HARDY, GORDON H.**
Simulation development of a forward sensor-enhanced low-altitude guidance system [HTN-94-00688] p 17 A95-60170
- HASDOERFF, L.**
Design and light evaluation of an integrated navigation and near-terrain helicopter guidance system for night-time and adverse weather operations [NASA-TM-108837] p 11 N95-10846
- HARRIS, CHARLES D.**
The NASA Langley 8-foot Transonic Pressure Tunnel calibration [NASA-TP-3437] p 8 N95-10739
- HASDOERFF, L.**
Design of a model following, state variable feedback controller for the X-14 VTOL aircraft [HTN-94-00685] p 16 A95-60168
- HEISER, W. H.**
Visualization of one-dimensional flow processes in a dual-mode scramjet engine p 15 N95-10465
- HEMSCH, MICHAEL J.**
Effect of passive venting on static pressure distributions in cavities at subsonic and transonic speeds [NASA-TM-4549] p 6 N95-10029
- HENDRICKS, R. C.**
Brush seal performance and durability issues based on T-700 engine test results [NASA-TM-106502] p 22 N95-11483
- HENNEQUIN, Y.**
Numerical study of Gortler instability: Application to the design of a quiet supersonic wind tunnel [PB94-184801] p 21 N95-10844

- HERNANDEZ, GLORIA**
Effect of leading- and trailing-edge flaps on clipped delta wings with and without wing camber at supersonic speeds [NASA-TM-4542] p 5 N95-10028
- HOFBECK, ERIC V.**
Transmission loss characteristics of aircraft sidewall systems to control cabin interior noise p 28 N95-11261
- HOFFLER, KEITH D.**
High-Alpha Research Vehicle (HARV) longitudinal controller: Design, analyses, and simulation results [NASA-TP-3446] p 17 N95-10860
- HOL, P. A.**
Reanalysis of European flight loads data [AD-A282052] p 9 N95-11179
- HOLLAND, K. R.**
Near field noise prediction requirements [ISVR-TR-234] p 27 N95-11166
- HOLLOWAY, C. MICHAEL**
Formal design and verification of a reliable computing platform for real-time control (phase 3 results) [NASA-TM-109140] p 33 N95-10873
- HOLST, TERRY L.**
Computational fluid dynamics uses in fluid dynamics/aerodynamics education [NASA-TM-108834] p 8 N95-10847
- HOMICZ, G. F.**
Navier-Stokes simulations of WECS airflow flowfields [DE94-013341] p 7 N95-10226
- HOQUE, MUHAMMED S.**
Dynamic response of NASA Rotor Test Apparatus and Sikorsky S-76 hub mounted in the 80- by 120-Foot Wind Tunnel [NASA-TM-108847] p 25 N95-11389
- HU, HONG**
Steady and unsteady three-dimensional transonic flow computations by integral equation method [NASA-CR-196777] p 10 N95-11582
- HUANG, JUI-TEN**
Advanced composites structural concepts and materials technologies for primary aircraft structures: Structural response and failure analysis: ISPAN modules users manual [NASA-CR-4449] p 12 N95-10242
- HUANG, JUI-TIEN**
Advanced composites structural concepts and materials technologies for primary aircraft structures: Structural response and failure analysis [NASA-CR-4448] p 11 N95-10240
- HUDSON, R. D.**
Eglin Air Force Base Ram Accelerator Research Facility p 19 N95-10284
- HUFF, DENNIS L.**
Flutter analysis of supersonic axial flow cascades using a high resolution Euler solver. Part 1: Formulation and validation [NASA-TM-105798] p 23 N95-10244
- INGRAM, J. ED**
Advanced composites structural concepts and materials technologies for primary aircraft structures: Design/manufacturing concept assessment [NASA-CR-4447] p 12 N95-10316
- INGRAM, J. EDWARD**
Advanced composites structural concepts and materials technologies for primary aircraft structures: Structural response and failure analysis [NASA-CR-4448] p 11 N95-10240
- INGRAM, J. EDWARD**
Advanced composites structural concepts and materials technologies for primary aircraft structures: Structural response and failure analysis: ISPAN modules users manual [NASA-CR-4449] p 12 N95-10242
- JACKMAN, CHARLES H.**
Three dimensional model calculations of the global dispersion of high speed aircraft exhaust and implications for stratospheric ozone loss p 26 N95-10657
- JOLLY, G. W.**
Validation of empirical orbit error corrections using crossover difference differences [HTN-94-00912] p 25 A95-60227
- JUNG, YOON**
Comprehensive aeromechanics analysis of complex rotorcraft using 2GCHAS [HTN-94-00695] p 2 A95-60174

H

L

- LAGIER, MARK T.**
An application of virtual prototyping to the flight test and evaluation of an unmanned air vehicle [AD-A281749] p 14 N95-11595
- LANDMANN, ALAN E.**
Effect of constraining layer stiffness on performance of damping tile materials using finite element modelling with Rayleigh integral p 30 N95-11306
- LANTERI, S.**
High performance parallel analysis of coupled problems for aircraft propulsion [NASA-CR-195355] p 23 N95-10132
- LARSON, KATE M. S.**
The present and future of aircraft noise models: A user's perspective p 32 N95-11324
- LAUCHLE, GERALD C.**
Empirical refinements to boundary layer transition noise models p 28 N95-11262
- LEAHY, MICHAEL B., JR.**
A generic telerobotics architecture for C-5 industrial processes [AIAA PAPER 94-1264-CP] p 27 N95-11529
- LEE, LEE S.**
Flame-spreading phenomena in the fin-slot region of a solid rocket motor p 23 N95-10296
- LEE, ROBERT A.**
Noise modeling for MOAs and ranges p 32 N95-11322
- LEWTER, W. J.**
A programmable heater control circuit for spacecraft [NASA-TM-108459] p 9 N95-11157
- LIBBY, P. A.**
Theories of turbulent combustion in high speed flows [AD-A280933] p 23 N95-10535
- LIGHT, JEFFREY S.**
Wing download reduction using vortex trapping plates [HTN-94-00710] p 4 A95-60188

An assessment of upper surface blowing for the reduction of tilt rotor download
[HTN-94-00711] p 5 A95-60189

Study of noise on a small-scale hovering tilt rotor
[HTN-94-00712] p 5 A95-60190

Aerodynamic interactions between a rotor and wing in hover
[HTN-94-00714] p 5 A95-60192

LITTRELL, D. M.

Eglin Air Force Base Ram Accelerator Research Facility
p 19 N95-10284

LUCAS, MICHAEL J.

Noise modeling for MOAs and ranges
p 32 N95-11322

M

MA, KWAN-LIU

3D visualization of unsteady 2D airplane wake vortices
[NASA-CR-194931] p 27 N95-11593

MAIAN, N.

High performance parallel analysis of coupled problems for aircraft propulsion
[NASA-CR-195355] p 23 N95-10132

MANSOUR, NAGI N.

A comparison of turbulence models in computing multi-element airfoil flows
[AIAA PAPER 94-0291] p 4 A95-60185

MARBOE, RICHARD C.

Empirical refinements to boundary layer transition noise models
p 28 N95-11262

MARGASON, RICHARD J.

Jet to freestream velocity ratio computations for a jet in a crossflow
[AIAA PAPER 93-4860] p 2 A95-60178

MARSHALL, STEVEN E.

Comments on the use of structureborne noise analysis for large commercial airplanes
p 30 N95-11267

MARUTHAYAPPAN, RAMAKRISHNAN

Plastic hinge modeling of structures
[NIAE-94-14] p 24 N95-11168

MARVIN, JOSEPH G.

Dryden lectureship in research, a perspective on CFD validation
[AIAA PAPER 93-0002] p 3 A95-60180

MASON, V. BRADFORD

Broadband, wide-area active control of sound radiated from vibrating structures using local surface-mounted radiation suppression devices
p 30 N95-11263

MATERN, DUANE

Application of an integrated methodology for propulsion and airframe control design to a STOVL aircraft
[NASA-TM-106729] p 16 N95-11159

MATTHEWS, MICHAEL P.

Future enhancements to ground-based microburst detection
p 11 N95-10570

MATTOON, JOSEPH S.

Instructional control and part/whole-task training: A review of the literature and an experimental comparison of strategies applied to instructional simulation
[AD-A260860] p 21 N95-10919

MAVRIPLIS, D. J.

Agglomeration multigrid for viscous turbulent flows
p 8 N95-10848

MAYNARD, S.

Novel matrix resins for composites for aircraft primary structures, phase 1
[NASA-CR-189657] p 23 N95-10318

MCCROSKEY, W. J.

Dynamic stall of an oscillating wing. Part 1: Evaluation of turbulence models
[AIAA PAPER 93-3403] p 3 A95-60184

MCDOWELL, P.

STOVL Control Integration Program
[NASA-CR-195358] p 18 N95-11487

MCGLOTHLIN, LARRY

MCAMAP: A model that combines several different kinds of aircraft operations
p 32 N95-11323

MCINERNEY, S. A.

An experimental investigation of wing tip turbulence with applications to aerosound
[AIAA PAPER 86-1918] p 1 A95-60164

MEECHAM, W. C.

An experimental investigation of wing tip turbulence with applications to aerosound
[AIAA PAPER 86-1918] p 1 A95-60164

MENEES, GENE P.

Experimental and analytical investigations of wave enhanced supersonic combustors
[AIAA PAPER 89-2787] p 14 A95-60172

MENTER, FLORIAN

A comparison of turbulence models in computing multi-element airfoil flows
[AIAA PAPER 94-0291] p 4 A95-60185

OSTROFF, AARON J.

High-Alpha Research Vehicle (HARV) longitudinal controller: Design, analyses, and simulation results
[NASA-TP-3446] p 17 N95-10860

OWEN, J. W.

A programmable heater control circuit for spacecraft
[NASA-TM-108459] p 9 N95-11157

P

PALMER, GRANT

A comparison of three-dimensional nonequilibrium solution algorithms applied to hypersonic flows with stiff chemical source terms
[AIAA PAPER 93-2861] p 4 A95-60186

PATTON, T.

Low frequency ultrasonic nondestructive inspection of aluminum/adhesive fuselage lap splices
[DE94-014242] p 24 N95-11135

PAULAUSKAS, M.

Flame-spreading phenomena in the fin-slot region of a solid rocket motor
p 23 N95-10296

PETERS, M. E.

A users manual for the method of moments Aircraft Modeling Code (AMC), version 2
[NASA-CR-196445] p 24 N95-11252

PETERSON, D. KENT

Active control of complex noise problems using a broadband, multichannel controller
p 29 N95-11271

PETERSON, RANDALL L.

Dynamic response of NASA Rotor Test Apparatus and Sikorsky S-76 hub mounted in the 80- by 120-Foot Wind Tunnel
[NASA-TM-108847] p 25 N95-11389

PHILLIPS, MICHAEL R.

High-Alpha Research Vehicle (HARV) longitudinal controller: Design, analyses, and simulation results
[NASA-TP-3446] p 17 N95-10860

PILIPENKO, V. V.

JPRS report: Science and technology. Central Eurasia: Engineering and equipment. Gas dynamics of supersonic shortened nozzles
[JPRS-UST-94-003-L] p 22 N95-10931

PIPERNO, S.

High performance parallel analysis of coupled problems for aircraft propulsion
[NASA-CR-195355] p 23 N95-10132

PITTS, FELIX L.

Fly-By-Light/Power-By-Wire Requirements and Technology Workshop
[NASA-CR-10108] p 12 N95-10245

PLENTOVICH, ELIZABETH B.

Effect of passive venting on static pressure distributions in cavities at subsonic and transonic speeds
[NASA-TM-4549] p 6 N95-10029

PODBOY, GARY G.

Effects of a forward-swept front rotor on the flowfield of a counterrotation propeller
[NASA-TM-106671] p 7 N95-10148

PRANST, P. S.

Inlet flow test calibration for a small axial compressor facility. Part 1: Design and experimental results
[NASA-TM-106719] p 16 N95-11005

PRATT, DAVID T.

Visualization of one-dimensional flow processes in a dual-mode scramjet engine
p 15 N95-10465

PROCTOR, FRED H.

Characteristics of a dry, pulsating microburst at Denver Stapleton Airport
p 26 N95-10568

PROFFITT, MELISSA S.

High-Alpha Research Vehicle (HARV) longitudinal controller: Design, analyses, and simulation results
[NASA-TP-3446] p 17 N95-10860

PUCKETT, P. M.

Novel matrix resins for composites for aircraft primary structures, phase 1
[NASA-CR-189657] p 23 N95-10318

PULLIAM, THOMAS H.

Accuracy enhancements for overset grids using a defect correction approach
[AIAA PAPER 94-0523] p 3 A95-60181

R

REAGON, PATRICIA G.

The NASA Langley 8-foot Transonic Pressure Tunnel calibration
[NASA-TP-3437] p 8 N95-10739

REDDY, T. S. R.

Flutter analysis of supersonic axial flow cascades using a high resolution Euler solver. Part 1: Formulation and validation
[NASA-TM-105798] p 23 N95-10244

MESAKI, YUJI

Research on an autonomous vision-guided helicopter
[AIAA PAPER 94-1240-CP] p 18 N95-11510

MESSINA, MICHAEL D.

High-Alpha Research Vehicle (HARV) longitudinal controller: Design, analyses, and simulation results
[NASA-TP-3446] p 17 N95-10860

MESTRE, VINCENT

Determining the effects of alternative departure cutback altitudes and power settings: A case study. John Wayne Airport
p 31 N95-11320

MEYN, LARRY A.

Optimum full-scale subsonic wind tunnel
[AIAA PAPER 86-0732] p 18 A95-60161

MILLER, D. P.

Inlet flow test calibration for a small axial compressor facility. Part 1: Design and experimental results
[NASA-TM-106719] p 16 N95-11005

MINEGISHI, M.

Aeroelastic tailoring research
p 6 N95-10135

MOLVIK, GREGORY A.

Development of an upwind, finite-volume code with finite-rate chemistry
[NASA-CR-196749] p 9 N95-11366

MOORE, P.

Validation of empirical orbit error corrections using crossover difference differences
[HTN-94-00912] p 25 A95-60227

MORT, K. W.

Optimum full-scale subsonic wind tunnel
[AIAA PAPER 86-0732] p 18 A95-60161

MOSHER, MARIANNE

Study of noise on a small-scale hovering tilt rotor
[HTN-94-00712] p 5 A95-60190

MULLINS, M. J.

Novel matrix resins for composites for aircraft primary structures, phase 1
[NASA-CR-189657] p 23 N95-10318

MURMAN, SCOTT M.

Numerical simulation of the flow about the F-18 HARV at high angle of attack
[NASA-CR-196396] p 9 N95-10940

N

NAGHSHINEH, KOOROSH

Broadband, wide-area active control of sound radiated from vibrating structures using local surface-mounted radiation suppression devices
p 30 N95-11283

NAKAMICHI, J.

Aeroelastic tailoring research
[PB94-180031] p 6 N95-10135

Computations of unsteady aerodynamic loads around oscillating wings. Part 1: Formulation
[PB94-180049] p 7 N95-10136

Computations of unsteady aerodynamic loads around oscillating wings. Part 2: Computed results and discussions
p 7 N95-10137

NALLASAMY, M.

Effects of a forward-swept front rotor on the flowfield of a counterrotation propeller
[NASA-TM-106671] p 7 N95-10148

NEJAD, A. S.

Numerical study of mixing in a high and low enthalpy supersonic test facility
p 7 N95-10467

NERAVETLA, B. R.

Effect of weak periodic pressure gradient on streamline vortices near a wall
p 29 N95-11263

NEWMAN, E. H.

A users manual for the method of moments Aircraft Modeling Code (AMC), version 2
[NASA-CR-196445] p 24 N95-11252

NGUYEN, D. D.

A programmable heater control circuit for spacecraft
[NASA-TM-108459] p 9 N95-11157

NOWLIN, WILLIAM C.

Active control of complex noise problems using a broadband, multichannel controller
p 29 N95-11271

O

ORMISTON, ROBERT A.

Comprehensive aeromechanics analysis of complex rotorcraft using 2GCHAS
[HTN-94-00695] p 2 A95-60174

First level release of 2GCHAS for comprehensive helicopter analysis - a status report
[HTN-94-00697] p 2 A95-60176

ORZECZOWSKI, JEFFREY M.

Effect of constraining layer stiffness on performance of damping tile materials using finite element modelling with Rayleigh integral
p 30 N95-11306

T

- TABACHNICK, BARBARA**
Assessing effects of military aircraft noise on residential property values near airbases p 31 N95-11310
- TETER, JOHN E., JR.**
Design and evaluation of candidate pressure ports for the HYFLITE experiment p 22 N95-11003
[NASA-TM-109146]
- TICHY, JIRI**
Achievements and tasks for active noise control p 29 N95-11270
- TIEN, C. L.**
Analysis of flow channeling near the wall in packed beds [HTN-94-00698] p 2 A95-60177
- TOTH, G. K.**
Broadband, wide-area active control of sound radiated from vibrating structures using local surface-mounted radiation suppression devices p 30 N95-11283
- TRACY, MAUREEN B.**
Effect of passive venting on static pressure distributions in cavities at subsonic and transonic speeds p 6 N95-10029
[NASA-TM-4549]
- TSO, JIN**
Jet to freestream velocity ratio computations for a jet in a crossflow p 2 A95-60178
[AIAA PAPER 93-4860]
- TU, J.**
Analysis of flow channeling near the wall in packed beds [HTN-94-00698] p 2 A95-60177
- TOTH, G. K.**
Broadband, wide-area active control of sound radiated from vibrating structures using local surface-mounted radiation suppression devices p 30 N95-11283
- TRACY, MAUREEN B.**
Effect of passive venting on static pressure distributions in cavities at subsonic and transonic speeds p 6 N95-10029
[NASA-TM-4549]
- TSO, JIN**
Jet to freestream velocity ratio computations for a jet in a crossflow p 2 A95-60178
[AIAA PAPER 93-4860]

V

- VAN DALSEM, WILLIAM R.**
Numerical simulation of powered-lift flows [HTN-94-00700] p 3 A95-60179
- VANDYKEN, R. D.**
Numerical simulation of a complete STOVLC aircraft in ground effect p 4 A95-60187
[AIAA PAPER 93-4880]
- VANGELDER, P. A.**
LDV measurements in dynamically separated flows [ISBN 0-8194-1311-9] p 5 A95-60191
- VANWIE, DAVID M.**
Reanalysis of European flight loads data [AD-A282052] p 9 N95-11179
- VENKATKRISHNAN, V.**
Application of scramjet engine technology to the design of ram accelerator projectiles p 19 N95-10282
- VENKATKRISHNAN, V.**
Agglomeration multigrid for viscous turbulent flows [NASA-CR-194953] p 8 N95-10848
- VENKATKRISHNAN, V.**
A comparison of three-dimensional nonequilibrium solution algorithms applied to hypersonic flows with stiff chemical source terms p 4 A95-60186
[AIAA PAPER 93-2861]
- VICROY, DAN D.**
Vertical wind estimation from horizontal wind measurements p 26 N95-10567
- VONFLOTOW, ANDREAS H.**
Adaptive tuned vibration absorbers: Tuning laws, tracking agility, sizing, and physical implementations p 25 N95-11280
- VONTHEIMER, ALFRED E.**
Design and evaluation of candidate pressure ports for the HYFLITE experiment p 22 N95-11003
[NASA-TM-109146]

W

- WATMUFF, JONATHAN H.**
Instabilities originating from suction holes used for Laminar Flow Control (LFC) p 6 N95-10131
[NASA-CR-196395]
- WATTS, S.**
STOVLC Control Integration Program p 18 N95-11487
[NASA-CR-195358]
- WEAVER, CLARK J.**
Three dimensional model calculations of the global dispersion of high speed aircraft exhaust and implications for stratospheric ozone loss p 26 N95-10657
- WEEKS, WILLIAM A.**
Active control of complex noise problems using a broadband, multichannel controller p 29 N95-11271
- WEISS, C.**
STOVLC Control Integration Program p 18 N95-11487
[NASA-CR-195358]
- WESTPHAL, RUSSELL V.**
Transonic flight test of a laminar flow leading edge with surface excrescences p 9 N95-11158
[NASA-TM-4597]
- WHITE, S. M.**
Analysis of flow channeling near the wall in packed beds p 2 A95-60177
[HTN-94-00698]
- SIMEI, FRANK A., JR.**
Development of an experimental facility for analysis of rotorodynamic phenomena p 25 N95-11330
[AD-A281897]
- SMITH, D. A.**
A programmable heater control circuit for spacecraft [NASA-TM-108459] p 9 N95-11157
- SMITH, MERRITT H.**
Numerical simulation of powered-lift flows [HTN-94-00700] p 3 A95-60179
- SMITH, ROBERT D.**
Numerical simulation of a complete STOVLC aircraft in ground effect p 4 A95-60187
[AIAA PAPER 93-4880]
- SMITH, ROBERT D.**
FAA vertical flight bibliography [DOT/FAA/RD-94/17] p 14 N95-11684
- SMITH, ROGERS E.**
Evaluation of F-18A approach and landing flying qualities using an in-flight simulator p 12 N95-10442
[CALSPAN-6241-F-1]
- SODERMAN, P. T.**
Optimum full-scale subsonic wind tunnel p 18 A95-60161
[AIAA PAPER 86-0732]
- SODERMAN, PAUL T.**
An experimental investigation of wing tip turbulence with applications to aerodynamic p 1 A95-60164
[AIAA PAPER 86-1918]
- SODERMAN, PAUL T.**
Aeroacoustic probe design for microphone to reduce flow-induced self-noise p 19 A95-60163
[AIAA PAPER 93-4343]
- SOEDER, RONALD H.**
On the scaling of small-scale jet noise to large scale p 27 A95-60166
[HTN-94-00681]
- SORENSEN, JOHN A.**
NASA Lewis Propulsion Systems Laboratory test article systems criteria p 20 N95-10446
[NASA-TM-106589]
- SORENSEN, JOHN A.**
NASA Lewis Propulsion Systems Laboratory customer guide manual p 21 N95-10822
[NASA-TM-106569]
- SOTOZAKI, T.**
ACSYS inner loop flight control design study p 17 N95-11223
[NASA-CR-196316]
- SRINIVASAN, G. R.**
Aeroelastic tailoring research p 6 N95-10135
[PB94-180031]
- SRINIVASAN, G. R.**
Navier-Stokes simulation of rotor-body flowfield in hover using overset grids p 1 A95-60160
[PAPER C15]
- STACY, KATHRYN**
Recent advances in Euler and Navier-Stokes methods for calculating helicopter rotor aerodynamics and acoustics p 2 A95-60169
[HTN-94-00686]
- STALLINGS, ROBERT L., JR.**
Dynamic stall of an oscillating wing. Part 1: Evaluation of turbulence models p 3 A95-60184
[AIAA PAPER 93-3403]
- STALLINGS, ROBERT L., JR.**
Computer-aided light sheet flow visualization using photogrammetry p 26 N95-10859
[NASA-TP-3416]
- STALLINGS, ROBERT L., JR.**
Effect of passive venting on static pressure distributions in cavities at subsonic and transonic speeds p 6 N95-10029
[NASA-TM-4549]
- STEPHENS, WENDELL B.**
First level release of ZGCHAS for comprehensive helicopter analysis - a status report p 2 A95-60176
[HTN-94-00697]
- STRELNIKOV, G. A.**
JPRS report: Science and technology. Central Eurasia: Engineering and equipment. Gas dynamics of supersonic shortened nozzles p 22 N95-10931
[JPRS-UST-94-003-L]
- STREML, PAUL M.**
Wing download reduction using vortex trapping plates [HTN-94-00710] p 4 A95-60188
- SWAFFORD, TIMOTHY W.**
Flutter analysis of supersonic axial flow cascades using a high resolution Euler solver. Part 1: Formulation and validation [NASA-TM-105798] p 23 N95-10244
- SWENSON, HARRY N.**
Simulation development of a forward sensor-enhanced low-altitude guidance system p 17 A95-60170
[HTN-94-00688]
- SWENSON, HARRY N.**
Design and flight evaluation of an integrated navigation and near-terrain helicopter guidance system for night-time and adverse weather operations p 11 N95-10846
[NASA-TM-108837]

- RISI, JOHN D.**
Analytical investigation of adaptive control of radiated inlet noise from turbid engines p 30 N95-11277
- RIVERS, ROBERT A.**
High-Alpha Research Vehicle (HARV) longitudinal controller: Design, analyses, and simulation results [NASA-TP-3446] p 17 N95-10860
- ROGERS, STUART E.**
Accuracy enhancements for overset grids using a defect correction approach p 3 A95-60181
[AIAA PAPER 94-0523]
- ROLADER, G. E.**
A comparison of turbulence models in computing multi-element airfoil flows p 4 A95-60185
[AIAA PAPER 94-0291]
- ROOD, RICHARD B.**
Eglin Air Force Base Ram Accelerator Research Facility p 19 N95-10284
- ROOD, RICHARD B.**
Three dimensional model calculations of the global dispersion of high speed aircraft exhaust and implications for stratospheric ozone loss p 26 N95-10657
- RUTKOWSKI, MICHAEL J.**
Comprehensive aeromechanics analysis of complex rotorcraft using ZGCHAS p 2 A95-60174
[HTN-94-00695]
- RUTKOWSKI, MICHAEL J.**
First level release of ZGCHAS for comprehensive helicopter analysis - a status report p 2 A95-60176
[HTN-94-00697]
- RUZICKA, GENE C.**
Comprehensive aeromechanics analysis of complex rotorcraft using ZGCHAS p 2 A95-60174
[HTN-94-00695]
- SABERI, HOSSEIN**
Comprehensive aeromechanics analysis of complex rotorcraft using ZGCHAS p 2 A95-60174
[HTN-94-00695]
- SCHMIDT, DAVID K.**
Extended cooperative control synthesis p 17 N95-10220
[NASA-TM-4561]
- SCHROEDER, JEFFERY A.**
Evaluation of simulation motion fidelity criteria in the vertical and directional axes p 18 A95-60156
[HTN-94-00666]
- SEKAR, BALU**
Numerical study of mixing in a high and low enthalpy supersonic test facility p 7 N95-10467
[HTN-94-00666]
- SERATI, PAUL M.**
Transmission loss characteristics of aircraft sidewall systems to control cabin interior noise p 28 N95-11261
- SEVERANCE, KURT**
Computer-aided light sheet flow visualization using photogrammetry p 26 N95-10859
[NASA-TP-3416]
- SHAH, BHARAT M.**
Advanced composites structural concepts and materials technologies for primary aircraft structures: Structural response and failure analysis p 11 N95-10240
[NASA-CR-4448]
- SHARP, BEN H.**
Advanced composites structural concepts and materials technologies for primary aircraft structures: Structural response and failure analysis: ISPAN modules users manual p 12 N95-10242
[NASA-CR-4449]
- SHAW, MICHAEL F.**
25 years of airport sound insulation programs p 31 N95-11307
- SHAW, MICHAEL F.**
A theoretical analysis of airborne sound transfer for a resiliently mounted machine to its foundation p 30 N95-11304
- SHAW, ROBERT J.**
A full Navier-Stokes analysis of subsonic diffuser of a bifurcated 70/30 supersonic inlet for high speed civil transport application p 8 N95-10820
[NASA-TM-106637]
- SHEPARDSON, KENNETH**
Integrating NOISEMAP with the Geographic Resource Analysis Support System (GRASS) to enhance environmental impact assessments and land use compatibility studies p 31 N95-11311
- SHUKLA, JAY G.**
Advanced composites structural concepts and materials technologies for primary aircraft structures: Design/manufacturing concept assessment p 12 N95-10316
[NASA-CR-4447]
- SILVATI, LAURA**
Assessing effects of military aircraft noise on residential property values near airbases p 31 N95-11310

S

- SABERI, HOSSEIN**
Comprehensive aeromechanics analysis of complex rotorcraft using ZGCHAS p 2 A95-60174
[HTN-94-00695]
- SCHMIDT, DAVID K.**
Extended cooperative control synthesis p 17 N95-10220
[NASA-TM-4561]
- SCHROEDER, JEFFERY A.**
Evaluation of simulation motion fidelity criteria in the vertical and directional axes p 18 A95-60156
[HTN-94-00666]
- SEKAR, BALU**
Numerical study of mixing in a high and low enthalpy supersonic test facility p 7 N95-10467
[HTN-94-00666]
- SERATI, PAUL M.**
Transmission loss characteristics of aircraft sidewall systems to control cabin interior noise p 28 N95-11261
- SEVERANCE, KURT**
Computer-aided light sheet flow visualization using photogrammetry p 26 N95-10859
[NASA-TP-3416]
- SHAH, BHARAT M.**
Advanced composites structural concepts and materials technologies for primary aircraft structures: Structural response and failure analysis p 11 N95-10240
[NASA-CR-4448]
- SHARP, BEN H.**
Advanced composites structural concepts and materials technologies for primary aircraft structures: Structural response and failure analysis: ISPAN modules users manual p 12 N95-10242
[NASA-CR-4449]
- SHAW, MICHAEL F.**
25 years of airport sound insulation programs p 31 N95-11307
- SHAW, MICHAEL F.**
A theoretical analysis of airborne sound transfer for a resiliently mounted machine to its foundation p 30 N95-11304
- SHAW, ROBERT J.**
A full Navier-Stokes analysis of subsonic diffuser of a bifurcated 70/30 supersonic inlet for high speed civil transport application p 8 N95-10820
[NASA-TM-106637]
- SHEPARDSON, KENNETH**
Integrating NOISEMAP with the Geographic Resource Analysis Support System (GRASS) to enhance environmental impact assessments and land use compatibility studies p 31 N95-11311
- SHUKLA, JAY G.**
Advanced composites structural concepts and materials technologies for primary aircraft structures: Design/manufacturing concept assessment p 12 N95-10316
[NASA-CR-4447]
- SILVATI, LAURA**
Assessing effects of military aircraft noise on residential property values near airbases p 31 N95-11310

WILLIAMS, F. A.

- WILLIAMS, F. A.**
Theories of turbulent combustion in high speed flows
[AD-A280933] p 23 N95-10535
- WINNERSTROEM, P.**
Propulsion research concerning SFRJ-motors
[PB94-179520] p 14 N95-10083
- WOO, EDMUND P.**
Novel matrix resins for composites for aircraft primary
structures, phase 1
[NASA-CR-189657] p 23 N95-10318
- WOOD, RICHARD M.**
Effect of leading- and trailing-edge flaps on clipped delta
wings with and without wing camber at supersonic
speeds
[NASA-TM-4542] p 5 N95-10028

Y

- YEAGER, DAVID M.**
Noise Con 1994: Proceedings of the 1994 National
Conference on Noise Control Engineering. Progress in
Noise Control for Industry p 28 N95-11259
- YEE, ZEE**
Flight test development and evaluation of a Kalman filter
state estimator for low-altitude flight
[HTN-94-00684] p 16 A95-60167
- YESIL, OKTAY**
Transmission loss characteristics of aircraft sidewall
systems to control cabin interior noise p 28 N95-11261
- YOUNG, CLARENCE P., JR.**
Effects of vibration on inertial wind-tunnel model attitude
measurement devices p 21 N95-11466
- [NASA-TM-109083]

Z

- ZELENKA, RICHARD E.**
Flight test development and evaluation of a Kalman filter
state estimator for low-altitude flight p 16 A95-60167
- [HTN-94-00684]
- Simulation development of a forward sensor-enhanced
low-altitude guidance system p 17 A95-60170
- Design and flight evaluation of an integrated navigation
and near-terrain helicopter guidance system for night-time
and adverse weather operations p 11 N95-10846
- [NASA-TM-108837]
- ZHENG, Z. C.**
3D visualization of unsteady 2D airplane wake vortices
[NASA-CR-194931] p 27 N95-11593
- ZHU, LI-PING**
Exact dynamic responses of periodic multi-span beams
under convected pressure fields p 25 N95-11288
- ZIMMERMAN, WAYNE**
A generic telerobotics architecture for C-5 industrial
processes p 27 N95-11529
- ZIRKLER, ANDRE**
Flight test development and evaluation of a Kalman filter
state estimator for low-altitude flight p 16 A95-60167
- [HTN-94-00684]
- Design and flight evaluation of an integrated navigation
and near-terrain helicopter guidance system for night-time
and adverse weather operations p 11 N95-10846
- [NASA-TM-108837]
- ZUNIGA, FANNY A.**
Transonic flight test of a laminar flow leading edge with
surface excrescences p 9 N95-11158
- [NASA-TM-4597]

Typical Corporate Source Index Listing

CORPORATE SOURCE			
TITLE	REPORT NUMBER	PAGE NUMBER	ACCESSION NUMBER
Colorado Univ., Boulder, CO. High performance parallel analysis of coupled problems for aircraft propulsion [NASA-CR-195355]		p 23	N95-10132

Listings in this index are arranged alphabetically by corporate source. The title of the document is used to provide a brief description of the subject matter. The page number and the accession number are included in each entry to assist the user in locating the abstract in the abstract section. If applicable, a report number is also included as an aid in identifying the document.

Calspan Advanced Technology Center, Buffalo, NY.
Evaluation of F-18A approach and landing flying qualities using an in-flight simulator
[ICALSPAN-6241-F-1] p 12 N95-10442

Carnegie-Mellon Univ., Pittsburgh, PA.
Research on an autonomous vision-guided helicopter
[AIAA PAPER 94-1240-CP] p 18 N95-11510

Colorado Univ., Boulder, CO.
High performance parallel analysis of coupled problems for aircraft propulsion
[NASA-CR-195355] p 23 N95-10132

D

Dow Chemical Co., Midland, MI.
Novel matrix resins for composites for aircraft primary structures, phase 1
[NASA-CR-189657] p 23 N95-10318

E

Ecole Nationale Supérieure de l'Aéronautique et de l'Espace, Toulouse (France).
Numerical study of Görtler instability: Application to the design of a quiet supersonic wind tunnel
[PB94-164801] p 21 N95-10844

F

Federal Aviation Administration, Washington, DC.
Airborne Windshear Detection and Warning Systems. Fifth and Final Combined Manufacturers' and Technologists' Conference, part 1
[NASA-CR-10139-PT-1] p 10 N95-10566

FAA vertical flight bibliography
[DOT/FAA/RD-94/17] p 14 N95-11684

Florida Atlantic Univ., Boca Raton, FL.
Effect of weak periodic pressure gradient on streamwise vortices near a wall
p 29 N95-11263

Exact dynamic responses of periodic multi-span beams under convected pressure fields
p 25 N95-11288

H

Hampton Univ., VA.
Steady and unsteady three-dimensional transonic flow computations by integral equation method
[NASA-CR-196777] p 10 N95-11582

Harris, Miller and Hanson, Inc., Lexington, MA.
The present and future of aircraft noise models: A user's perspective
p 32 N95-11324

Hood Technology Corp., Hood River, OR.
Adaptive tuned vibration absorbers: Tuning laws, tracking agility, sizing, and physical implementations
p 25 N95-11280

I

Institute for Computer Applications in Science and Engineering, Hampton, VA.
Agglomeration multigrid for viscous turbulent flows
[NASA-CR-194953] p 8 N95-10848

3D visualization of unsteady 2D airplane wake vortices
[NASA-CR-194931] p 27 N95-11593

Institute of Noise Control Engineering, Poughkeepsie, NY.
Noise Con 1994: Proceedings of the 1994 National Conference on Noise Control Engineering Progress in Noise Control for Industry
[ILC-75-24750] p 28 N95-11259

Istanbul Univ. (Turkey).
At Istanbul-Ataturk Airport measurement and analysis of noise in due of take-off time
p 31 N95-11319

C

California Univ., San Diego, La Jolla, CA.
Theories of turbulent combustion in high speed flows
[AD-A280933] p 23 N95-10535

J

Jet Propulsion Lab., California Inst. of Tech., Pasadena, CA.
A generic telerobotics architecture for C-5 industrial processes
[AIAA PAPER 94-1264-CP] p 27 N95-11529

Johns Hopkins Univ., Laurel, MD.
Application of scramjet engine technology to the design of ram accelerator projectiles
p 19 N95-10282

Joint Publications Research Service, Arlington, VA.
JPRS report: Science and technology. Central Eurasia: Engineering and equipment. Gas dynamics of supersonic shortened nozzles
[JPRS-UST-94-003-L] p 22 N95-10931

L

Lockheed Aeronautical Systems Co., Marietta, GA.
Advanced composites structural concepts and materials technologies for primary aircraft structures: Structural response and failure analysis
[NASA-CR-4448] p 11 N95-10240

Advanced composites structural concepts and materials technologies for primary aircraft structures. Structural response and failure analysis: ISPAN modules users manual
[NASA-CR-4449] p 12 N95-10242

Advanced composites structural concepts and materials technologies for primary aircraft structures: Design/manufacturing concept assessment
[NASA-CR-4447] p 12 N95-10316

Loral Systems, Inc., Orlando, FL.
Advanced distributed simulation technology advanced rotary wing aircraft. Strawman verification and validation plan for the ARWA simulator system
[AD-A280237] p 19 N95-10349

Advanced distributed simulation technology advanced rotary wing aircraft. System/segment specification. Volume 1: Simulation system module
[AD-A280238] p 20 N95-10350

Advanced distributed simulation technology advanced rotary wing aircraft. System/segment specification. Volume 3: Visual system module
[AD-A280239] p 20 N95-10351

Advanced distributed simulation technology advanced rotary wing aircraft. System/segment specification. Volume 2: Flight station module
[AD-A280432] p 20 N95-10352

Advanced distributed simulation technology advanced rotary wing aircraft. System/segment specification. Volume 5: Simulation system module AH-64D kit
[AD-A280433] p 20 N95-10353

Advanced distributed simulation technology advanced rotary wing aircraft. Software reusability report
[AD-A280434] p 20 N95-10354

M

Massachusetts Inst. of Tech., Lexington.
Future enhancements to ground-based microburst detection
p 11 N95-10570

MCAT Inst., San Jose, CA.
Instabilities originating from suction holes used for Laminar Flow Control (LFC)
[NASA-CR-196395] p 6 N95-10131

Numerical simulation of the flow about the F-18 HARV at high angle of attack
[NASA-CR-196396] p 9 N95-10940

High speed civil transport: Sonic boom softening and aerodynamic optimization
[NASA-CR-196397] p 28 N95-11192

Development of an upwind, finite-volume code with finite-rate chemistry
[NASA-CR-196749] p 9 N95-11366

Computational analysis of forebody tangential slot blowing on the high alpha research vehicle
[NASA-CR-196750] p 10 N95-11367

Mestre Greve Associates, Newport Beach, CA.
Determining the effects of alternative departure cutback altitudes and power settings: A case study. John Wayne Airport p 31 N95-11320
Mitsubishi Heavy Industries Ltd., Tokyo (Japan).
Activities of Mitsubishi Heavy Industries Ltd. p 22 N95-10085
[PB94-179694]

N

National Aeronautics and Space Administration, Washington, DC.
The High Speed Research Program p 10 N95-10548
The model builders p 20 N95-10552
[NASA-TM-109902] p 22 N95-10553
Aero-Space Plane: Flexible access to space p 22 N95-10553
Scientific balloons p 7 N95-10556
[NASA-TM-109904]
General Aviation Task Force report p 1 N95-11463
[NASA-TM-109950]

National Aeronautics and Space Administration, Ames Research Center, Moffett Field, CA.
Validation of the dynamic response of a blade-element UH-60 simulation model in hovering flight p 18 A95-60155
Evaluation of simulation motion fidelity criteria in the vertical and directional axes p 18 A95-60156
[HTN-94-00686]
Navier-Stokes simulation of rotor-body flowfield in hover using overset grids p 1 A95-60160
[PAPER C15]
Optimum full-scale subsonic wind tunnel p 18 A95-60161
[AIAA PAPER 86-0732]
Aeroacoustic probe design for microphone to reduce flow-induced self-noise p 19 A95-60163
[AIAA PAPER 93-4343]
An experimental investigation of wing tip turbulence with applications to aerosound p 1 A95-60164
[AIAA PAPER 86-1918]
Oblique incidence sound absorption of porous materials covered by perforated metal and exposed to tangential airflow p 19 A95-60165
[HTN-94-00681]
On the scaling of small-scale jet noise to large scale p 27 A95-60166
[AIAA PAPER 92-02109]
Flight test development and evaluation of a Kaiman filter state estimator for low-altitude flight p 16 A95-60167
[HTN-94-00684]

Design of a model following, state variable feedback controller for the X-14 VTOL aircraft p 16 A95-60168
Recent advances in Euler and Navier-Stokes methods for calculating helicopter rotor aerodynamics and acoustics p 2 A95-60169
[HTN-94-00686]
Simulation development of a forward sensor-enhanced low-altitude guidance system p 17 A95-60170
[HTN-94-00688]
Experimental and analytical investigations of wave enhanced supersonic combustors p 14 A95-60172
[AIAA PAPER 89-2787]
Computation of nonequilibrium viscous flows in arc-jet wind tunnel nozzles p 2 A95-60173
[AIAA PAPER 94-0254]
Jet to freestream velocity ratio computations for a jet in a crossflow p 2 A95-60178
[AIAA PAPER 93-4860]
Numerical simulation of powered-lift flows p 3 A95-60179
[HTN-94-00700]
Dryden lectureship in research, a perspective on CFD validation p 3 A95-60180
[AIAA PAPER 93-0002]
Accuracy enhancements for overset grids using a defect correction approach p 3 A95-60181
[AIAA PAPER 94-0523]
Interferometry and computational studies of an oscillating airfoil compressible dynamic stall flow field p 3 A95-60182
[HTN-94-00703]

Dynamic stall of an oscillating wing. Part 1: Evaluation of turbulence models p 3 A95-60184
[AIAA PAPER 93-3403]
A comparison of turbulence models in computing multi-element airfoil flows p 4 A95-60185
[AIAA PAPER 94-0291]
A comparison of three-dimensional nonequilibrium solution algorithms applied to hypersonic flows with stiff chemical source terms p 4 A95-60186
[AIAA PAPER 93-2861]
Numerical simulation of a complete STOVL aircraft in ground effect p 4 A95-60187
[AIAA PAPER 93-4880]
Wing download reduction using vortex trapping plates p 4 A95-60188
[HTN-94-00710]

An assessment of upper surface blowing for the reduction of lift rotor download p 5 A95-60189
[HTN-94-00711]
Study of noise on a small-scale hovering lift rotor p 5 A95-60190
[HTN-94-00712]
LDV measurements in dynamically separated flows p 5 A95-60191
[ISBN 0-8194-1311-9]
Aerodynamic interactions between a rotor and wing in hover p 5 A95-60192
[HTN-94-00714]
A study of compressibility effects on dynamic stall of rapidly pitching airfoils p 5 A95-60193
[HTN-94-00715]
Design and flight evaluation of an integrated navigation and near-terrain helicopter guidance system for night-time and adverse weather operations p 11 N95-10846
[NASA-TM-108837]

Computational fluid dynamics uses in fluid dynamics/aerodynamics education p 8 N95-10847
[NASA-TM-108834]
Dynamic response of NASA Rotor Test Apparatus and Sikorsky S-76 hub mounted in the 80- by 120-Foot Wind Tunnel p 25 N95-11389
[NASA-TM-108847]
National Aeronautics and Space Administration, Goddard Space Flight Center, Greenbelt, MD.
Three dimensional model calculations of the global dispersion of high speed aircraft exhaust and implications for stratospheric ozone loss p 26 N95-10857
National Aeronautics and Space Administration, Hugh L. Dryden Flight Research Center, Edwards, CA.
Dryden and transonic research p 1 N95-10709
[NASA-TM-104281]
Dryden overview for schools p 21 N95-10710
[NASA-TM-104282]
F-18 HARV presentation for industry p 13 N95-10711
[NASA-TM-104283]
Dryden tour tape, 1994 p 21 N95-10714
[NASA-TM-104288]
Research excitation system flight testing p 13 N95-10715
[NASA-TM-104289]
NASA and the SR-71: Back to the future p 13 N95-10716
[NASA-TM-104290]
Radio controlled for research p 17 N95-10717
[NASA-TM-104292]
The crash of Flight 232 p 11 N95-10737
[NASA-TM-104279]
Building the Integrated Test Facility: A foundation for the future p 21 N95-10738
[NASA-TM-104280]
HL-10 dedication ceremony p 13 N95-10740
[NASA-TM-104295]
F-104 resource tape p 13 N95-10741
[NASA-TM-104296]
F-15 835 (HIDEC) resource tape p 13 N95-10742
[NASA-TM-104297]
F-16XL resource tape p 13 N95-10743
[NASA-TM-104298]
F-16 high alpha research vehicle resource tape p 13 N95-10744
[NASA-TM-104299]
X-31 resource tape p 13 N95-10745
[NASA-TM-104300]
The Western Aeronautical Test Range p 21 N95-10746
[NASA-TM-104301]
Dryden overview for schools p 21 N95-10747
[NASA-TM-104302]
F-15 Propulsion Controlled Aircraft (PCA) p 17 N95-10748
[NASA-TM-104303]
NACA/NASA: X-1 through X-31 p 1 N95-10749
[NASA-TM-104304]
Dryden summer 1994 update p 33 N95-10750
[NASA-TM-104305]
X-31 tailless testing p 13 N95-10751
[NASA-TM-104306]

National Aeronautics and Space Administration, Hugh L. Dryden Flight Research Facility, Edwards, CA.
Flow-visualization study of the X-29A aircraft at high angles of attack using a 1/48-scale model p 8 N95-10858
[NASA-TM-104288]
Transonic flight test of a laminar flow leading edge with surface excrescences p 9 N95-11158
[NASA-TM-4597]
On the use of controls for subsonic transport performance improvement: Overview and future directions p 10 N95-11408
[NASA-TM-4605]
National Aeronautics and Space Administration, Langley Research Center, Hampton, VA.
Effect of leading- and trailing-edge flaps on clipped delta wings with and without wing camber at supersonic speeds p 5 N95-10028
[NASA-TM-4542]
Effect of passive venting on static pressure distributions in cavities at subsonic and transonic speeds p 6 N95-10029
[NASA-TM-4549]

Two-dimensional converging-diverging rippled nozzles at transonic speeds p 6 N95-10129
[NASA-TP-3440]
Extended cooperative control synthesis p 17 N95-10220
[NASA-TM-4561]
Fly-By-Light/Power-By-Wire Requirements and Technology Workshop p 12 N95-10245
[NASA-CP-10108]
Langley overview p 20 N95-10547
[NASA-TM-108891]
Airborne Windshear Detection and Warning Systems. Fifth and Final Combined Manufacturers' and Technologists' Conference, part 1 p 10 N95-10566
[NASA-CP-10139-PT-1]
Vertical wind estimation from horizontal wind measurements p 26 N95-10567
Characteristics of a dry, pulsating microburst at Denver Stapleton Airport p 26 N95-10568
The NASA Langley 8-foot Transonic Pressure Tunnel calibration p 8 N95-10739
[NASA-TP-3437]
Computer-aided light sheet flow visualization using photogrammetry p 26 N95-10859
[NASA-TP-3416]
High-Alpha Research Vehicle (HARV) longitudinal controller: Design, analyses, and simulation results p 17 N95-10860
[NASA-TP-3446]
Formal design and verification of a reliable computing platform for real-time control (phase 3 results) p 33 N95-10873
[NASA-TM-109140]
Design and evaluation of candidate pressure ports for the HYFLITE experiment p 22 N95-11003
[NASA-TM-109146]
The use of the Regier number in the structural design with flutter constraints p 13 N95-11465
[NASA-TM-109128]
Effects of vibration on inertial wind-tunnel model attitude measurement devices p 21 N95-11466
[NASA-TM-109083]
Potential impacts of advanced aerodynamic technology on air transportation system productivity p 10 N95-11489
[NASA-TM-109154]
NASA-TM-109154 p 10 N95-11489

National Aeronautics and Space Administration, Lewis Research Center, Cleveland, OH.
Effect of wind tunnel acoustic modes on linear oscillating cascade aerodynamics p 14 A95-60199
[HTN-94-00760]
Effects of a forward-swept front rotor on the flowfield of a counterrotating propeller p 7 N95-10148
[NASA-TM-106671]
An aerodynamic analysis of a mixed flow turbine p 15 N95-10153
[NASA-TM-106674]
Flutter analysis of supersonic axial flow cascades using a high resolution Euler solver. Part 1: Formulation and validation p 23 N95-10244
[NASA-TM-105798]
NASA Lewis Propulsion Systems Laboratory test article systems criteria p 20 N95-10446
[NASA-TM-106589]
A full Navier-Stokes analysis of subsonic diffuser of a blurcated 70/30 supersonic inlet for high speed civil transport application p 8 N95-10820
[NASA-TM-106637]
NASA Lewis Propulsion Systems Laboratory customer guide manual p 21 N95-10822
[NASA-TM-106569]
Control of wind tunnel operations using neural net interpretation of flow visualization records p 24 N95-10854
[NASA-TM-106683]
Inlet flow test calibration for a small axial compressor facility. Part 1: Design and experimental results p 16 N95-11005
[NASA-TM-106719]
Application of an integrated methodology for propulsion and airframe control design to a STOVL aircraft p 16 N95-11159
[NASA-TM-106729]
Fan noise research at NASA p 28 N95-11260
Radiant energy measurements from a scaled jet engine axisymmetric exhaust nozzle for a baseline code validation case p 25 N95-11409
[NASA-TM-106686]
Brush seal performance and durability issues based on T-700 engine test results p 22 N95-11483
[NASA-TM-106502]

National Aeronautics and Space Administration, Marshall Space Flight Center, Huntsville, AL.
A programmable heater control circuit for spacecraft p 9 N95-11157
[NASA-TM-108459]
National Aerospace Lab., Amsterdam (Netherlands).
Reanalysis of European flight loads data p 9 N95-11179
[AD-A282052]
National Aerospace Lab., Tokyo (Japan).
Aeroelastic tailoring research p 6 N95-10135
[PB94-180031]
Computations of unsteady aerodynamic loads around oscillating wings. Part 1: Formulation p 7 N95-10136
[PB94-180049]

Computations of unsteady aerodynamic loads around oscillating wings. Part 2: Computed results and discussions
[PB94-180056] p 7 N95-10137

National Center for Atmospheric Research, Boulder, CO.

Determining F-factor using ground-based Doppler radar: Validation and results
p 11 N95-10571

National Defence Research Establishment, Stockholm (Sweden).

Propulsion research concerning SFRJ-motors
[PB94-179520] p 14 N95-10083

Naval Air Test Center, Patuxent River, MD.

Evaluation of F-18A approach and landing flying qualities using an in-flight simulator
[CALSPAN-6241-F-1] p 12 N95-10442

Naval Postgraduate School, Monterey, CA.

Development of an experimental facility for analysis of rotodynamic phenomena
[AD-A281897] p 25 N95-11330

An application of virtual prototyping to the flight test and evaluation of an unmanned air vehicle
[AD-A281749] p 14 N95-11595

Naval Sea Systems Command, Washington, DC.

A theoretical analysis of airborne sound transfer for a resiliently mounted machine to its foundation
p 30 N95-11304

O

Ohio State Univ., Columbus.

A users manual for the method of moments Aircraft Modeling Code (AMC), version 2
[NASA-CR-196445] p 24 N95-11252

P

Pennsylvania State Univ., State College, PA.

Empirical refinements to boundary layer transition noise models
p 28 N95-11262

Pennsylvania State Univ., University Park, PA.

Flame-spreading phenomena in the fin-slot region of a solid rocket motor
p 23 N95-10296

Achievements and tasks for active noise control
p 29 N95-11270

Planning Research Corp., Edwards, CA.

High-angle-of-attack yawing moment asymmetry of the X-31 aircraft from flight test
[NASA-CR-186030] p 13 N95-11410

Pratt and Whitney Aircraft, West Palm Beach, FL

STOVL Control Integration Program
[NASA-CR-195358] p 18 N95-11487

Purdue Univ., West Lafayette, IN.

Active control of turbomachine discrete tones
p 29 N95-11275

S

Sandia National Labs., Albuquerque, NM.

Navier-Stokes simulations of WECS airfoil flowfields
[DE94-013341] p 7 N95-10226

Seagull Technology, Inc., Sunnyvale, CA.

ACSNT inner loop flight control design study
[NASA-CR-196316] p 17 N95-11223

Southampton Univ. (England).

Near field noise prediction requirements
[ISVR-TR-234] p 27 N95-11166

Spectrum Sciences and Software, Inc., Fort Walton Beach, FL.

Integrating NOISEMAP with the Geographic Resource Analysis Support System (GRASS) to enhance environmental impact assessments and land use compatibility studies
p 31 N95-11311

MOAMAP: A model that combines several different kinds of aircraft operations
p 32 N95-11323

SRI International Corp., Menlo Park, CA.

Active control of complex noise problems using a broadband, multichannel controller
p 29 N95-11271

Broadband, wide-area active control of sound radiated from vibrating structures using local surface-mounted radiation suppression devices
p 30 N95-11283

T

Texas Univ., San Antonio, TX.

Micro-measurements of mechanical properties for adhesives and composites using digital imaging technology
[NASA-CR-196111] p 22 N95-10231

Toledo Univ., OH.

Modeling improvements and users manual for axial-flow turbine off-design computer code AXOD
[NASA-CR-195370] p 8 N95-10853

U

United Technologies Research Center, East Hartford, CT.

Computational fluid dynamics study of the variable-pitch split-blade fan concept
[NASA-CR-189206] p 15 N95-10247

Hydrocarbon-fueled ramjet/scramjet technology program, phase 2 extension
[NASA-CR-189659] p 15 N95-10319

Universität der Bundeswehr Muenchen, Neubiberg (Germany).

The 4-D approach to visual control of autonomous systems
[AIAA PAPER 94-1243-CP] p 27 N95-11513

University of Southern California, Los Angeles, CA.

Programmed ignition of metal compounds in a scramjet
p 16 N95-10466

V

Virginia Polytechnic Inst. and State Univ., Blacksburg, VA.

Active control of interior noise in a business jet using piezoceramic actuators
p 29 N95-11276

Analytical investigation of adaptive control of radiated inlet noise from turbofan engines
p 30 N95-11277

W

Washington Univ., Seattle, WA.

Visualization of one-dimensional flow processes in a dual-mode scramjet engine
p 15 N95-10465

Wichita State Univ., KS.

Plastic hinge modeling of structures
[NIAR-94-141] p 24 N95-11168

Wright Lab., Eglin AFB, FL

Eglin Air Force Base Ram Accelerator Research Facility
p 19 N95-10284

Wright Lab., Wright-Patterson AFB, OH.

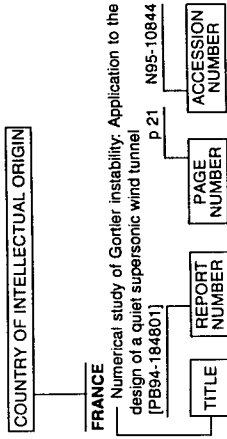
Numerical study of mixing in a high and low enthalpy supersonic test facility
p 7 N95-10467

Wyle Labs., Inc., Arlington, VA.

25 years of airport sound insulation programs
p 31 N95-11307

Noise modeling for MOAs and ranges
p 32 N95-11322

Typical Foreign Technology Index Listing



Listings in this index are arranged alphabetically by country of intellectual origin. The title of the document is used to provide a brief description of the subject matter. The page number and accession number are included in each entry to assist the user in locating the abstract in the abstract section. If applicable, a report number is also included as an aid in identifying the document.

R

RUSSIA
JPRS report. Science and technology. Central Eurasia: Engineering and equipment. Gas dynamics of supersonic shortened nozzles
[JPRS-UST-94-003-L] p 22 N95-10931

S

SWEDEN
Propulsion research concerning SFRJ-motors
[PB94-179520] p 14 N95-10083

T

TURKEY
AT Istanbul-Ataturk Airport measurement and analysis of noise in due of take-off time p 31 N95-11319

U

UNITED KINGDOM
Validation of empirical orbit error corrections using crossover difference differences p 25 A95-60227
[HTN-94-00912]
Near field noise prediction requirements
[ISVR-TR-234] p 27 N95-11166

F

FRANCE
Numerical study of Gortler instability: Application to the design of a quiet supersonic wind tunnel
[PB94-184801] p 21 N95-10844

G

GERMANY
The 4-D approach to visual control of autonomous systems
[AIAA PAPER 94-1243-CP] p 27 N95-11513

J

JAPAN
Activities of Mitsubishi Heavy Industries Ltd.
[PB94-179694] p 22 N95-10085
Aeroelastic tailoring research
[PB94-180031] p 6 N95-10135
Computations of unsteady aerodynamic loads around oscillating wings. Part 1: Formulation
[PB94-180049] p 7 N95-10136
Computations of unsteady aerodynamic loads around oscillating wings. Part 2: Computed results and discussions
[PB94-180056] p 7 N95-10137

N

NETHERLANDS
Reanalysis of European flight loads data
[AD-A282052] p 9 N95-11179

CONTRACT NUMBER INDEX

January 1995

AERONAUTICAL ENGINEERING / A Continuing Bibliography (Supplement 313)

Typical Contract Number Index Listing

N00014-82-K-0185	p 22	N95-10231
CONTRACT NUMBER	PAGE NUMBER	ACCESSION NUMBER

Listings in this index are arranged alphabetically by contract number. Under each contract number the accession numbers denoting documents that have been produced as a result of research done under the contract are shown. The accession number denotes the number by which the citation is identified in the abstract section. Preceding the accession number is the page number on which the citation may be found.

RTOP 232-01-04-01	p 10	N95-11489
RTOP 232-01-04	p 22	N95-11483
RTOP 307-50-00	p 24	N95-10854
RTOP 505-59-10-30	p 8	N95-10739
RTOP 505-59-10	p 9	N95-11158
RTOP 505-59-30-01	p 5	N95-10028
RTOP 505-59-36	p 25	N95-11389
RTOP 505-59-54-01	p 21	N95-11466
RTOP 505-62-10	p 15	N95-10153
	p 16	N95-11005
RTOP 505-62-30-01	p 6	N95-10129
RTOP 505-62-40-01	p 15	N95-10319
RTOP 505-62-50	p 16	N95-11159
RTOP 505-62-70	p 25	N95-11409
RTOP 505-62-84	p 20	N95-10446
	p 21	N95-10822
RTOP 505-63-50-06	p 13	N95-11465
RTOP 505-64-10-09	p 12	N95-10245
RTOP 505-64-12-01	p 10	N95-10566
RTOP 505-64-36	p 11	N95-10846
RTOP 505-64-50-03	p 33	N95-10873
RTOP 505-64-52-01	p 17	N95-10220
RTOP 505-68-30-05	p 17	N95-10860
RTOP 505-68-32	p 18	N95-11487
RTOP 505-68-70-08	p 6	N95-10029
RTOP 505-69-10	p 10	N95-11408
RTOP 505-69-50	p 8	N95-10853
RTOP 505-90-52-01	p 8	N95-10848
	p 27	N95-11593
RTOP 505-90-53-02	p 26	N95-10859
RTOP 509-10-00	p 8	N95-10847
RTOP 510-02-11-02	p 23	N95-10318
RTOP 510-02-13-01	p 11	N95-10240
	p 12	N95-10316
	p 13	N95-11410
RTOP 533-02-00	p 8	N95-10856
RTOP 533-02-38	p 23	N95-10244
RTOP 535-03-10	p 8	N95-10820
RTOP 537-02-23	p 7	N95-10148
RTOP 538-03-11	p 22	N95-11003
RTOP 763-01-51-25	p 23	N95-10132
RTOP 509-10-11	p 22	N95-10231
T2-341085/8B03	p 24	N95-11135
W-7405-ENG-82		

AFOSR-MIPR-88-0010	p 5	A95-60193
DAAL03-90-C-0013	p 3	A95-60169
	p 3	A95-60184
MIPR-AR0-137-86	p 5	A95-60193
MIPR-114-91	p 5	A95-60191
MIPR-130-92	p 5	A95-60191
MIPR-92-0004	p 5	A95-60191
NCC2-420	p 2	A95-60173
CR-4303-430220	p 22	N95-10231
DA PROJ 1L1-62211-A-47-A	p 15	N95-10153
DE-AC04-94AL-85000	p 7	N95-10226
F19628-90-C-0002	p 11	N95-10570
F33615-78-C-3602	p 12	N95-10442
F49620-92-J-0184	p 23	N95-10535
NAG1-1058	p 24	N95-11252
NAG1-1170	p 10	N95-11582
NAG1-1437	p 27	N95-11593
NAG1-230	p 30	N95-11277
NAG3-1165	p 8	N95-10853
NAG3-1425	p 23	N95-10132
NAS ASC-92-17394	p 15	N95-10132
NAS1-17794	p 23	N95-10319
NAS1-18841	p 23	N95-10318
NAS1-18888	p 11	N95-10240
	p 12	N95-10242
	p 12	N95-10316
NAS1-19480	p 8	N95-10848
	p 27	N95-11593
NAS2-13534	p 1	A95-60160
NAS2-13701	p 17	N95-11223
NAS3-25117	p 15	N95-10247
NAS3-25194	p 18	N95-11487
NAS3-25266	p 16	N95-11005
NAS3-27186	p 7	N95-10148
	p 16	N95-11159
NCC10-5	p 25	N95-11288
NCC2-498	p 9	N95-11366
NCC2-617	p 28	N95-11192
NCC2-657	p 10	N95-11367
NCC2-698	p 6	N95-10131
NCC2-724	p 22	N95-10231
NCC2-729	p 9	N95-10940
NSF BCS-92-11847	p 29	N95-11263
N00014-82-K-0185	p 22	N95-10231
N61339-91-D-0001	p 19	N95-10349
	p 20	N95-10350
	p 20	N95-10351
	p 20	N95-10352
	p 20	N95-10353
	p 20	N95-10354
PROJ 90-19	p 9	N95-11157

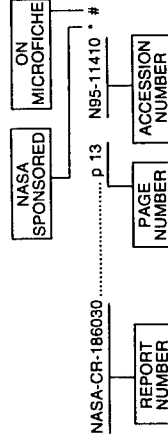
CONTRACT

REPORT NUMBER INDEX

AERONAUTICAL ENGINEERING / A Continuing Bibliography (Supplement 313)

January 1995

Typical Report Number Index Listing



Listings in this index are arranged alphabetically by report number. The page number indicates the page on which the citation is located. The accession number denotes the number by which the citation is identified. An asterisk (*) indicates that the item is a NASA report. A pound sign (#) indicates that the item is available on microfiche.

Typical Report Number Index Listing

REPORT NUMBER

PAGE NUMBER

ACCESSION NUMBER

NASA SPONSORED

ON MICROFICHE

NASA-CR-186030

p 13

N95-11410

*

Listings in this index are arranged alphabetically by report number. The page number indicates the page on which the citation is located. The accession number denotes the number by which the citation is identified. An asterisk (*) indicates that the item is a NASA report. A pound sign (#) indicates that the item is available on microfiche.

A-94105	p 8	N95-10847	*
A-94112	p 11	N95-10846	*
A-94133	p 25	N95-11389	*
AD-A280237	p 19	N95-10349	#
AD-A280238	p 20	N95-10350	#
AD-A280239	p 20	N95-10351	#
AD-A280432	p 20	N95-10352	#
AD-A280433	p 20	N95-10353	#
AD-A280434	p 20	N95-10354	#
AD-A280860	p 21	N95-10319	#
AD-A280933	p 23	N95-10535	#
AD-A281749	p 14	N95-11595	#
AD-A281897	p 25	N95-11330	#
AD-A282052	p 9	N95-11179	#
AD-B167205L	p 15	N95-10319	*

ADST/TR-94-003276-VOL-2	p 20	N95-10352	#
ADST/TR-94-003276-VOL-5	p 20	N95-10353	#
ADST/TR-94-003281	p 20	N95-10354	#
ADST/TR94-003276-VOL-1	p 20	N95-10350	#
ADST/TR94-003276-VOL-3	p 20	N95-10351	#
ADST/TR94-003282	p 19	N95-10349	#
AFOSR-94-0375TR	p 23	N95-10535	#
AIAPA PAPER 86-0732	p 18	N95-60161	*
AIAPA PAPER 86-1918	p 1	N95-60164	*
AIAPA PAPER 89-2787	p 14	N95-60172	*
AIAPA PAPER 92-02109	p 27	N95-60166	*
AIAPA PAPER 93-0002	p 3	N95-60180	*
AIAPA PAPER 93-2861	p 4	N95-60186	*
AIAPA PAPER 93-3403	p 3	N95-60184	*
AIAPA PAPER 93-4343	p 19	N95-60163	*
AIAPA PAPER 93-4860	p 2	N95-60178	*
AIAPA PAPER 93-4880	p 4	N95-60187	*
AIAPA PAPER 94-0254	p 2	N95-60173	*
AIAPA PAPER 94-0291	p 4	N95-60185	*
AIAPA PAPER 94-0523	p 3	N95-60181	*
AIAPA PAPER 94-1240-CP	p 18	N95-11510	*
AIAPA PAPER 94-1243-CP	p 27	N95-11513	*
AIAPA PAPER 94-1264-CP	p 27	N95-11529	*
AIAPA PAPER 94-1803	p 13	N95-11410	*
AIAPA PAPER 94-2142	p 9	N95-11158	*
AIAPA PAPER 94-2690	p 16	N95-11005	*
AIAPA PAPER 94-2694	p 7	N95-10148	*
AIAPA PAPER 94-3515	p 10	N95-11408	*
AIAPA PAPER 94-3611	p 16	N95-11159	*
AL/HR-TR-1994-0041	p 21	N95-10919	#
ARL-TR-572	p 15	N95-10153	*

CALSPAN-6241-F-1	p 12	N95-10442	#
CONF-9405-48-3	p 7	N95-10226	#
DE94-013341	p 7	N95-10226	#
DE94-014242	p 24	N95-11135	#
DOT/FAA/CT-94/21	p 9	N95-11179	#
DOT/FAA/RD-94/14-PT-1	p 10	N95-10566	*
DOT/FAA/RD-94/17	p 14	N95-11684	#
E-7229	p 23	N95-10244	*
E-8520	p 22	N95-11483	*
E-8769	p 21	N95-10822	*
E-8856	p 20	N95-10446	*
E-8939	p 28	N95-10820	#
E-8994	p 23	N95-10148	*
E-9007	p 27	N95-10132	*
E-9008	p 15	N95-10153	*
E-9023	p 18	N95-11487	*
E-9034	p 24	N95-10854	*
E-9042	p 25	N95-11409	*
E-9052	p 8	N95-10853	*
E-9085	p 16	N95-11005	*
E-9104	p 16	N95-11159	*
ESL-TR-727282-6	p 24	N95-11252	*
FOA-C-20963-2.1	p 14	N95-10083	#
H-1918	p 8	N95-10858	*
H-1994	p 9	N95-11158	*
H-2002	p 10	N95-11408	*
H-2015	p 13	N95-11410	*
HTN-94-00663	p 18	N95-60155	*
HTN-94-00666	p 18	N95-60156	*
HTN-94-00673	p 1	N95-60160	*
HTN-94-00674	p 18	N95-60161	*
HTN-94-00677	p 19	N95-60163	*
HTN-94-00678	p 1	N95-60164	*
HTN-94-00681	p 19	N95-60165	*
HTN-94-00682	p 27	N95-60166	*
HTN-94-00684	p 16	N95-60167	*
HTN-94-00685	p 16	N95-60168	*
HTN-94-00686	p 17	N95-60169	*
HTN-94-00688	p 17	N95-60170	*
HTN-94-00692	p 14	N95-60172	*
HTN-94-00694	p 2	N95-60173	*
HTN-94-00695	p 2	N95-60174	*
HTN-94-00697	p 2	N95-60176	*
HTN-94-00698	p 2	N95-60177	*
HTN-94-00699	p 2	N95-60178	*
HTN-94-00700	p 3	N95-60179	*
HTN-94-00701	p 3	N95-60180	*
HTN-94-00702	p 3	N95-60181	*
HTN-94-00703	p 3	N95-60182	*
HTN-94-00704	p 3	N95-60183	*
HTN-94-00705	p 4	N95-60184	*
HTN-94-00707	p 4	N95-60185	*
HTN-94-00708	p 4	N95-60186	*
HTN-94-00709	p 4	N95-60187	*
HTN-94-00710	p 4	N95-60188	*
HTN-94-00711	p 5	N95-60189	*
HTN-94-00712	p 5	N95-60190	*
HTN-94-00713	p 5	N95-60191	*
HTN-94-00714	p 5	N95-60192	*
HTN-94-00715	p 5	N95-60193	*
HTN-94-00760	p 14	N95-60199	*
HTN-94-00912	p 25	N95-60227	*
ICASE-94-45	p 27	N95-11593	*
ICASE-94-62	p 8	N95-10848	*
IS-T-1681	p 24	N95-11135	#
ISBN 0-8194-1311-9	p 5	N95-60191	*
ISBN 0-931784-27-1	p 28	N95-11259	#
ISVR-TR-234	p 27	N95-11166	#
JPRS-UST-94-003-L	p 22	N95-10931	#
L-17212	p 17	N95-10220	*
L-17265	p 6	N95-10129	*
L-17272	p 5	N95-10028	*
L-17291	p 26	N95-10859	*
L-17299	p 6	N95-10029	*
L-17322	p 8	N95-10739	*
L-17323	p 17	N95-10860	*
LC-75-24750	p 28	N95-11259	#
LG92ER0035	p 11	N95-10240	*
LG92ER0036	p 12	N95-10242	*
MCAT-94-01	p 9	N95-11366	*
MCAT-94-10	p 28	N95-11192	*
MCAT-94-11	p 9	N95-10940	*
MCAT-94-22	p 10	N95-11367	*
MCAT-94-23	p 6	N95-10131	*
NAL/TR-1202-PT-1	p 7	N95-10136	#
NAL/TR-1203-PT-2	p 7	N95-10137	#
NAL/TR-1208	p 6	N95-10135	#
NAS 1.15:104268	p 8	N95-10856	*
NAS 1.15:105798	p 23	N95-10244	*
NAS 1.15:106502	p 22	N95-11483	*
NAS 1.15:106569	p 22	N95-10822	*
NAS 1.15:106589	p 20	N95-10446	*
NAS 1.15:106637	p 8	N95-10820	*
NAS 1.15:106671	p 7	N95-10148	*
NAS 1.15:106674	p 15	N95-10153	*
NAS 1.15:106683	p 24	N95-10854	*
NAS 1.15:106686	p 25	N95-11409	*
NAS 1.15:106719	p 16	N95-11005	*
NAS 1.15:106729	p 16	N95-11159	*
NAS 1.15:108459	p 9	N95-11157	*
NAS 1.15:108834	p 11	N95-10847	*
NAS 1.15:108837	p 8	N95-10846	*
NAS 1.15:108847	p 25	N95-11389	*
NAS 1.15:108873	p 21	N95-11466	*
NAS 1.15:109083	p 21	N95-11465	*
NAS 1.15:109128	p 33	N95-10873	*
NAS 1.15:109140	p 22	N95-11003	*
NAS 1.15:109146	p 10	N95-11489	*
NAS 1.15:109154	p 1	N95-11463	*
NAS 1.15:109590	p 5	N95-10028	*
NAS 1.15:15452	p 6	N95-10220	*
NAS 1.15:15459	p 17	N95-10220	*
NAS 1.15:15497	p 9	N95-11158	*
NAS 1.15:154605	p 10	N95-11408	*
NAS 1.15:154605	p 13	N95-11410	*
NAS 1.26:186030	p 15	N95-10247	*
NAS 1.26:186206	p 23	N95-10247	*
NAS 1.26:189237	p 15	N95-10318	*
NAS 1.26:189657	p 23	N95-10319	*
NAS 1.26:189659	p 15	N95-10319	*
NAS 1.26:194831	p 27	N95-11593	*
NAS 1.26:194953	p 8	N95-10848	*
NAS 1.26:195358	p 18	N95-10132	*
NAS 1.26:195358	p 8	N95-10853	*
NAS 1.26:195370	p 22	N95-10231	*
NAS 1.26:196111	p 17	N95-1223	*
NAS 1.26:196316	p 6	N95-10131	*
NAS 1.26:196395	p 6	N95-10131	*
NAS 1.26:196396	p 9	N95-10940	*
NAS 1.26:196397	p 28	N95-11192	*
NAS 1.26:196399	p 24	N95-11252	*
NAS 1.26:196445	p 9	N95-11366	*
NAS 1.26:196749	p 10	N95-11367	*
NAS 1.26:196750	p 10	N95-11582	*
NAS 1.26:196777	p 12	N95-10316	*
NAS 1.26:4447	p 11	N95-10240	*
NAS 1.26:4448	p 12	N95-10242	*
NAS 1.55:10108	p 12	N95-10245	*
NAS 1.55:10139-PT-1	p 10	N95-10566	*
NAS 1.60:3416	p 26	N95-10859	*
NAS 1.60:3437	p 8	N95-10739	*
NAS 1.60:3440	p 17	N95-10129	*
NAS 1.60:3446	p 17	N95-10860	*
NASA-CP-10108	p 12	N95-10245	*
NASA-CP-10139-PT-1	p 10	N95-10566	*

NASA-CR-186030

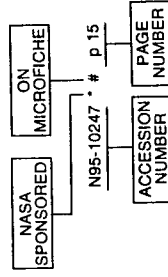
NASA-CR-186030		p 13	N95-11410 * #	NONP-NASA-VT-94-23635		p 13	N95-10715 *
NASA-CR-186206	.....	p 15	N95-10247 * #	NONP-NASA-VT-94-23636	.....	p 13	N95-10716 *
NASA-CR-189657	.....	p 23	N95-10318 * #	NONP-NASA-VT-94-23637	.....	p 17	N95-10717 *
NASA-CR-189659	.....	p 15	N95-10319 * #	NONP-NASA-VT-94-23640	.....	p 13	N95-10740 *
NASA-CR-194931	.....	p 27	N95-11593 * #	NONP-NASA-VT-94-23641	.....	p 13	N95-10741 *
NASA-CR-194953	.....	p 8	N95-10848 * #	NONP-NASA-VT-94-23642	.....	p 13	N95-10742 *
NASA-CR-195355	.....	p 23	N95-10132 * #	NONP-NASA-VT-94-23643	.....	p 13	N95-10743 *
NASA-CR-195358	.....	p 18	N95-11487 * #	NONP-NASA-VT-94-23644	.....	p 13	N95-10744 *
NASA-CR-195370	.....	p 8	N95-10853 * #	NONP-NASA-VT-94-23645	.....	p 13	N95-10745 *
NASA-CR-195370	.....	p 8	N95-10853 * #	NONP-NASA-VT-94-23646	.....	p 21	N95-10746 *
NASA-CR-196111	.....	p 22	N95-11231 * #	NONP-NASA-VT-94-23647	.....	p 21	N95-10747 *
NASA-CR-196316	.....	p 17	N95-11223 * #	NONP-NASA-VT-94-23648	.....	p 17	N95-10748 *
NASA-CR-196395	.....	p 6	N95-10131 * #	NONP-NASA-VT-94-23649	.....	p 1	N95-10749 *
NASA-CR-196396	.....	p 9	N95-10940 * #	NONP-NASA-VT-94-23650	.....	p 33	N95-10750 *
NASA-CR-196397	.....	p 28	N95-11192 * #	NONP-NASA-VT-94-23651	.....	p 13	N95-10751 *
NASA-CR-196445	.....	p 24	N95-11252 * #	PAPER C15	.....	p 1	A95-60160 *
NASA-CR-196749	.....	p 9	N95-11366 * #	PB94-179520	.....	p 14	N95-10083
NASA-CR-196750	.....	p 10	N95-11367 * #	PB94-179694	.....	p 22	N95-10085
NASA-CR-196777	.....	p 10	N95-11582 * #	PB94-180031	.....	p 6	N95-10135
NASA-CR-4447	.....	p 12	N95-10316 * #	PB94-180049	.....	p 7	N95-10137
NASA-CR-4448	.....	p 11	N95-10240 * #	PB94-180056	.....	p 7	N95-10137
NASA-CR-4449	.....	p 12	N95-10242 * #	PB94-184801	.....	p 21	N95-10844
NASA-TM-104268	.....	p 8	N95-10858 * #	REPT-73-C1	.....	p 12	N95-10316 * #
NASA-TM-104279	.....	p 11	N95-10737 * #	REPT-93122-01	.....	p 17	N95-11223 * #
NASA-TM-104280	.....	p 21	N95-10738 * #	SAND-93-4037C	.....	p 7	N95-10226 #
NASA-TM-104281	.....	p 1	N95-10709 * #	UTRC-R91-254576-20	.....	p 15	N95-10247 * #
NASA-TM-104282	.....	p 21	N95-10710 * #	UTSA-MM2-6274	.....	p 22	N95-10231 * #
NASA-TM-104283	.....	p 13	N95-10711 * #				
NASA-TM-104288	.....	p 21	N95-10714 * #				
NASA-TM-104289	.....	p 13	N95-10715 * #				
NASA-TM-104290	.....	p 13	N95-10716 * #				
NASA-TM-104291	.....	p 17	N95-10717 * #				
NASA-TM-104292	.....	p 13	N95-10740 * #				
NASA-TM-104295	.....	p 13	N95-10741 * #				
NASA-TM-104296	.....	p 13	N95-10742 * #				
NASA-TM-104297	.....	p 13	N95-10743 * #				
NASA-TM-104298	.....	p 13	N95-10744 * #				
NASA-TM-104299	.....	p 13	N95-10745 * #				
NASA-TM-104300	.....	p 13	N95-10746 * #				
NASA-TM-104301	.....	p 21	N95-10747 * #				
NASA-TM-104302	.....	p 21	N95-10748 * #				
NASA-TM-104303	.....	p 17	N95-10749 * #				
NASA-TM-104304	.....	p 1	N95-10749 * #				
NASA-TM-104305	.....	p 33	N95-10750 * #				
NASA-TM-104306	.....	p 13	N95-10751 * #				
NASA-TM-104306	.....	p 13	N95-10244 * #				
NASA-TM-105798	.....	p 23	N95-11483 * #				
NASA-TM-106502	.....	p 22	N95-11483 * #				
NASA-TM-106569	.....	p 21	N95-10822 * #				
NASA-TM-106569	.....	p 20	N95-10446 * #				
NASA-TM-106589	.....	p 8	N95-10820 * #				
NASA-TM-106637	.....	p 7	N95-10148 * #				
NASA-TM-106671	.....	p 8	N95-10847 * #				
NASA-TM-106674	.....	p 15	N95-10153 * #				
NASA-TM-106683	.....	p 24	N95-10854 * #				
NASA-TM-106686	.....	p 25	N95-11409 * #				
NASA-TM-106719	.....	p 16	N95-11005 * #				
NASA-TM-106729	.....	p 16	N95-11159 * #				
NASA-TM-108459	.....	p 9	N95-11157 * #				
NASA-TM-108459	.....	p 8	N95-10847 * #				
NASA-TM-108834	.....	p 11	N95-10846 * #				
NASA-TM-108837	.....	p 25	N95-11389 * #				
NASA-TM-108847	.....	p 21	N95-11466 * #				
NASA-TM-109083	.....	p 13	N95-11465 * #				
NASA-TM-109128	.....	p 33	N95-10873 * #				
NASA-TM-109140	.....	p 33	N95-11003 * #				
NASA-TM-109146	.....	p 22	N95-11489 * #				
NASA-TM-109154	.....	p 10	N95-11489 * #				
NASA-TM-109869	.....	p 10	N95-10548 * #				
NASA-TM-109891	.....	p 20	N95-10547 * #				
NASA-TM-109902	.....	p 20	N95-10552 * #				
NASA-TM-109904	.....	p 22	N95-10553 * #				
NASA-TM-109907	.....	p 7	N95-10556 * #				
NASA-TM-109950	.....	p 1	N95-11463 * #				
NASA-TM-4542	.....	p 5	N95-10028 * #				
NASA-TM-4549	.....	p 6	N95-10029 * #				
NASA-TM-4561	.....	p 17	N95-10220 * #				
NASA-TM-4597	.....	p 9	N95-11158 * #				
NASA-TM-4605	.....	p 10	N95-11408 * #				
NASA-TP-3416	.....	p 26	N95-10859 * #				
NASA-TP-3437	.....	p 8	N95-10739 * #				
NASA-TP-3440	.....	p 6	N95-10129 * #				
NASA-TP-3446	.....	p 17	N95-10860 * #				
NIAR-94-14	.....	p 24	N95-11168 #				
NLR-TP-93535L	.....	p 9	N95-11179 #				
NONP-NASA-VT-94-23139	.....	p 20	N95-10547 *				
NONP-NASA-VT-94-23140	.....	p 10	N95-10548 *				
NONP-NASA-VT-94-23144	.....	p 20	N95-10552 *				
NONP-NASA-VT-94-23146	.....	p 22	N95-10553 *				
NONP-NASA-VT-94-23149	.....	p 7	N95-10556 *				
NONP-NASA-VT-94-23217	.....	p 11	N95-10737 *				
NONP-NASA-VT-94-23628	.....	p 21	N95-10738 *				
NONP-NASA-VT-94-23629	.....	p 1	N95-10709 *				
NONP-NASA-VT-94-23630	.....	p 13	N95-10710 *				
NONP-NASA-VT-94-23631	.....	p 13	N95-10711 *				
NONP-NASA-VT-94-23634	.....	p 21	N95-10714 *				

ACCESSION NUMBER INDEX

January 1995

AERONAUTICAL ENGINEERING / A Continuing Bibliography (Supplement 313)

Typical Accession Number Index Listing



Listings in this index are arranged alphanumerically by accession number. The page number indicates the page on which the citation is located. The accession number denotes the number by which the citation is identified. An asterisk (*) indicates that the item is a NASA report. A pound sign (#) indicates that the item is available on microfiche.

A95-60155 *	p 18	N95-10247 * #	p 15
A95-60156 *	p 18	N95-10282 *	p 19
A95-60160 *	p 1	N95-10284 *	p 19
A95-60161 *	p 18	N95-10285 *	p 19
A95-60163 *	p 19	N95-10296 *	p 23
A95-60164 *	p 1	N95-10316 * #	p 12
A95-60165 *	p 19	N95-10318 * #	p 23
A95-60166 *	p 27	N95-10319 * #	p 15
A95-60167 *	p 16	N95-10349 *	p 19
A95-60168 *	p 16	N95-10350 *	p 20
A95-60169 *	p 2	N95-10351 *	p 20
A95-60170 *	p 17	N95-10352 *	p 20
A95-60172 *	p 14	N95-10353 *	p 20
A95-60173 *	p 2	N95-10354 *	p 20
A95-60174 *	p 2	N95-10442 *	p 12
A95-60176 *	p 2	N95-10446 * #	p 20
A95-60177 *	p 2	N95-10465 *	p 15
A95-60178 *	p 2	N95-10466 *	p 16
A95-60179 *	p 3	N95-10467 *	p 7
A95-60180 *	p 3	N95-10535 *	p 23
A95-60181 *	p 3	N95-10547 *	p 20
A95-60182 *	p 3	N95-10548 *	p 10
A95-60183 *	p 3	N95-10552 *	p 20
A95-60184 *	p 3	N95-10553 *	p 22
A95-60185 *	p 4	N95-10556 *	p 7
A95-60186 *	p 4	N95-10566 *	p 10
A95-60187 *	p 4	N95-10567 *	p 26
A95-60188 *	p 4	N95-10568 *	p 26
A95-60189 *	p 5	N95-10570 * #	p 11
A95-60190 *	p 5	N95-10571 * #	p 11
A95-60191 *	p 5	N95-10572 *	p 26
A95-60192 *	p 5	N95-10657 *	p 1
A95-60193 *	p 5	N95-10709 *	p 1
A95-60199 *	p 14	N95-10710 *	p 21
A95-60227 *	p 25	N95-10711 *	p 13
		N95-10714 *	p 21
		N95-10715 *	p 13
N95-10028 * #	p 5	N95-10716 *	p 17
N95-10029 * #	p 6	N95-10717 *	p 17
N95-10083 *	p 14	N95-10737 *	p 11
N95-10085 *	p 22	N95-10738 *	p 21
N95-10129 * #	p 6	N95-10739 * #	p 8
N95-10131 * #	p 6	N95-10740 *	p 13
N95-10132 * #	p 23	N95-10741 *	p 13
N95-10135 *	p 6	N95-10742 *	p 13
N95-10136 *	p 7	N95-10743 *	p 13
N95-10137 *	p 7	N95-10744 *	p 13
N95-10148 * #	p 7	N95-10745 *	p 13
N95-10153 * #	p 15	N95-10746 *	p 21
N95-10220 * #	p 17	N95-10747 *	p 21
N95-10226 *	p 7	N95-10748 *	p 17
N95-10231 * #	p 22	N95-10749 *	p 1
N95-10240 * #	p 11	N95-10750 *	p 33
N95-10242 * #	p 12	N95-10751 *	p 13
N95-10244 * #	p 23	N95-10820 * #	p 8
N95-10245 * #	p 12	N95-10822 * #	p 21

N95-10844 *	p 21	N95-11366 * #	p 25
N95-10846 * #	p 11	N95-11367 *	p 10
N95-10847 * #	p 8	N95-11369 *	p 25
N95-10848 * #	p 8	N95-11408 * #	p 10
N95-10853 * #	p 8	N95-11409 * #	p 25
N95-10854 * #	p 24	N95-11410 * #	p 13
N95-10858 * #	p 8	N95-11463 * #	p 1
N95-10859 * #	p 26	N95-11465 * #	p 13
N95-10860 * #	p 17	N95-11466 * #	p 21
N95-10873 * #	p 33	N95-11483 * #	p 22
N95-10919 *	p 21	N95-11487 * #	p 18
N95-10931 *	p 22	N95-11489 * #	p 10
N95-10940 * #	p 9	N95-11510 *	p 18
N95-11003 * #	p 22	N95-11513 *	p 27
N95-11005 * #	p 16	N95-11529 *	p 27
N95-11135 * #	p 24	N95-11582 * #	p 10
N95-11157 * #	p 9	N95-11593 * #	p 27
N95-11158 * #	p 9	N95-11595 *	p 14
N95-11159 * #	p 16	N95-11684 *	p 14
N95-11166 *	p 27		
N95-11168 *	p 24		
N95-11179 *	p 9		
N95-11192 * #	p 28		
N95-11223 * #	p 17		
N95-11252 * #	p 24		
N95-11259 *	p 28		
N95-11260 * #	p 28		
N95-11261 *	p 28		
N95-11262 *	p 28		
N95-11263 *	p 29		
N95-11270 *	p 29		
N95-11271 *	p 29		
N95-11275 * #	p 29		
N95-11276 *	p 29		
N95-11277 * #	p 30		
N95-11280 *	p 25		
N95-11283 *	p 30		
N95-11287 *	p 30		
N95-11288 * #	p 25		
N95-11304 *	p 30		
N95-11306 *	p 30		
N95-11307 *	p 31		
N95-11310 *	p 31		
N95-11311 *	p 31		
N95-11319 *	p 31		
N95-11320 *	p 31		
N95-11321 *	p 31		
N95-11322 *	p 32		
N95-11323 *	p 32		
N95-11324 *	p 32		
N95-11330 *	p 25		
N95-11366 * #	p 9		
N95-11367 *	p 10		
N95-11389 *	p 25		
N95-11408 * #	p 10		
N95-11409 * #	p 25		
N95-11410 * #	p 13		
N95-11463 * #	p 1		
N95-11465 * #	p 13		
N95-11466 * #	p 21		
N95-11483 * #	p 22		
N95-11487 * #	p 18		
N95-11489 * #	p 10		
N95-11510 *	p 18		
N95-11513 *	p 27		
N95-11529 *	p 27		
N95-11582 * #	p 10		
N95-11593 * #	p 27		
N95-11595 *	p 14		
N95-11684 *	p 14		

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